An Environmental Information System for Planners

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Statement of Originality

This thesis represents a body of work undertaken between June 2001 and May 2011 part-time, and part-funded by the Natural Environment Research Council (NERC) URGENT research programme, the Department of Communities and Local Government (and its predecessor bodies) and the British Geological Survey. This work was significantly multidisciplinary in nature combining research into environmental data sets, their application to the UK planning system and the development of an information system to use them within that planning context. As such there was a team of approximately 20 researchers from across these disciplines involved in the content of this work. The author of this thesis is recognised as the lead in the development of the information system described here throughout the work, including its application to the UK planning framework. He is the only individual who has made a significant contribution to the design of *all* of the environmental decision flows described here and formally project led the work since 2002. After discussion with my supervisors, it has been agreed that the author of this thesis contributed 50-75% of the ‘originality’ of chapters 2,3,4,5 and 6 (where they relate to work completed up to 2003-2004). All work since 2004 is at least 90% that of the author.

Acknowledgements

The author would like to extend a big thank you for the great patience of his three supervisors, Professor. John Farmer, Dr. Andy Mcleod and Professor Martin Culshaw in waiting for the birth of this thesis from what was a part time enterprise which was progressed to conclusion through not always continual and therefore periodic funding from different sources such as the Natural Environment Research Council (NERC) URGENT research programme, the Department of Communities and Local Government (and its predecessor bodies) and the British Geological Survey(BGS) . The British Geological Survey must be thanked for contributing the great majority of the tuition fees and Professor Culshaw of the BGS, as Principal Investigator of the URGENT funded project and my regular, continual and enthusiastic supervisor and encourager to complete the thesis, deserves the biggest thanks of all.

Many researchers contributed to the data and content of the EISP over the length of the work and I thank and list the significant contributors here with apologies to any I have missed: Sandra Alker, Ruth Swetnam, John Packman, Bill Bealey, Jason Careless, Jonathan Lowndes, Jeff Parker, Patrick Bell, Helen Davies, Andy Gibson, Mike Lelliott, Martin Culshaw, David Bridge, Graham Leeks, David Fowler, Paul Nathanail, Barry Wyatt, Richard Wadsworth, Roger Moore and Helen Reeves.

A final thank you to my long suffering spouse, Madeleine Lawrie – who whilst quite pleased that I was ‘out of the house’ on many a weekend and evening working on this thesis – she, like me, has been looking forward to seeing me a bit more often from now on!

Abstract

This research proposes an on-line Environmental Information System for Planners (EISP). The Environmental Information System for Planners has been developed in collaboration with five local authorities as a web-based system designed to support decision making within the UK planning framework. It has been built as a 'proof-of-concept' system to demonstrate the value to urban planning of making information on environmental issues more widely accessible.

The EISP has been designed to support three principal planning functions carried out by Local Authorities: Pre-planning enquiries; Development control decisions; and Strategic planning. The system incorporates 12 environmental themes: Air quality (PM10); Shallow undermining; Landslide susceptibility; Groundwater protection; Flood risk; Drainage; Land contamination; Proximity to landfill; Biodiversity; Natural heritage designations; Man-made heritage; and Natural Ground Stability (Geohazards). The design framework is based upon a series of decision flow diagrams, each covering one of the above themes. These decision flows take account of current planning procedures in the UK. Industry-standard web technologies have been employed to integrate the flows and develop the functionality that will allow the planner access to the system through secure web pages. Underpinning the system is an environmental Geographical Information System (GIS) that contains the most up-to-date data, information and models relevant to each of the environmental themes listed. The planning regulations are subject to change and so the system has been designed in a modular way so that new legislation can be accommodated without the need for a complete system rewrite. This modular approach also means that the system can be readily adapted to reflect local priorities and to draw on local datasets.

The EISP was successfully tested and the thesis concludes with a costed business case study for commercial implementation and rollout of a production EISP system populated with appropriate environmental data within UK local authorities.

Contents

List of figures

List of Tables

Chapter 1 Introduction

The Urban Regeneration and the Environment Programme (URGENT – see http://urgent.nerc.ac.uk/about.htm) was a wide-ranging research programme concerned with the restoration and regeneration of urban conurbations in the UK. The programme started in late 1996 and had a budget of £9.7 million over 7 years. The programme aimed to integrate urban ecological and environmental research across the geological, terrestrial, freshwater and atmospheric sciences. It was funded and managed by the UK Natural Environment Research Council (NERC) as one of their thematic programmes, but worked in partnership with city authorities, industry and regulatory bodies. The URGENT programme funded 41 projects in UK Institutes and Universities covering a wide variety of scientific research and generated data, models and other information outputs (Swetnam, 2001) across a broad spectrum.

In addition to funding high quality scientific research into urban environments, one of the primary aims of the programme was to link the needs of decision-makers and users concerned with reclamation and management of the urban environment with the latest research on new techniques to underpin their day to day work. The work of the project 'EIS for Planners' was therefore a key mechanism to deliver the outputs of URGENT and other urban research to the stakeholders and other interested parties.

Against this background, DTLR (the department of Transport Local Goverment and the regions, becoming the Office of the Deputy Prime Minister ODPM and now Department of Communities and Local Government DCLG) and NERC commissioned the development of a prototype decision support system for use by Local Authorities in the planning process. The aim of the system was to help planners make the best use of Environmental Information and predictive modelling systems in preparing strategic plans and controlling development. It was stressed that any viable system needed to be constructed in a manner which could accommodate dynamic change in regulatory procedures and guidance. The original 'URGENT – EIS for Planners' initiative worked alongside other DTLR projects that were incorporating mechanisms for 'e-government' at the local government level. As such, it was anticipated that the decision system should support 'Best Value' initiatives and provide added value to the planning process by providing better environmental information for informed decision making.

Additionally, consideration of the environmental aspects of regeneration and development projects formed an integral part of sustainable development. Central Government promotes the consideration of sustainable development within planning and has also introduced 'Quality of Life' indicators, used to measure achievement toward sustainability and progress in environmental performance. These 150 indicators www.sustainable-development.gov.uk/sustainable/quality99/annexa.htm include environmental aspects and targets, such as air quality targets and open space availability in the urban context. Provision of the best available environmental information within what became an Environmental Information System for Planners (EISP) aimed to assist Local Authorities in delivering the environmental performance aspects of these initiatives within planning.

Environmental information is used in both development control planning decisions for the granting of planning permissions and for strategic planning - forward planning for the location of facilities and environmental management e.g. Air Quality Management Plans. The key questions to address in the construction of a decision aid for the use of environmental information in planning are:

- Which environmental issues should be examined?
- What are the conditions that need to be met in order to allow a development to proceed?
- Where / How could this type of development or land use allocation be best achieved?

1.1 Aims and Objectives

The aim of this thesis is to propose that it is possible to build such a system that uses the most appropriate and accessible digital environmental datasets available for the UK planning context that will actually support, as a tool, the work of town and country planners in the UK. The potential for such tools is discussed by Geertman and Stillwell (2001) as the technology drivers, including availability of digital useful environmental datasets) for their practical implementation became available at the start of the 21st century.

This requires the following objectives:

- Investigate where environmental information is, could and should be used in the UK planning framework
- Investigate where and how such information is actually used in active Local Planning Authorities (LPA)
- Investigate what human expertise and IT systems LPAs have and in what direction they are developing
- Determine what relevant datasets are available/will be available to address the environmental issues that are defined in the planning framework
- Investigate the shortfalls in existing availability of systems, data and application of information systems in active LPAs
- Design, implement, test and cost a suitable environmental information system for planners

These research steps, are documented in required order in the following chapters. Chapter 2 of the thesis, Environmental Information in the UK planning System, reviews the planning system and the role and use of environmental data by Local Planning Authorities and consultants that participated in this research. Chapter 3, Decision Support Systems in the planning domain, reviews existing academic and production tools and its conclusions together with the planning context review lead to chapter 4, A Functional Specification for an Environmental Information Planning Tool. Chapter 5 describes the Design and implementation of a web-based EISP and chapter 6 describes the environmental planning topic modules or logical flows that made up the implemented prototype EISP with the testing feedback from the local authorities that helped design and trial the system. Chapter 7 is a business case study for production implementation of the EISP that proposes a cost/benefit business case for moving the prototype system into in-house production implementations provided by commercial planning support companies.

The thesis concludes that it is possible to create a practical UK planning system applicable system at a cost similar to tools already being used by planners. A CD attached to the rear of the manuscript contains the User Guide for the latest EISP system with many visual runs of the logic responding to real planning scenarios. This allows any reader of this thesis to get a detailed visualisation explanation of each flow in action and they therefore may not need to apply for a password to access the web-based system directly. Passwords for research purposes are available by application to the author as long as the system is maintained on-line.

References

GEERTMAN, S, AND STILLWELL, J. (Eds) 2001 Planning Support Systems in Practice. Springer Verlag, Berlin. ISBN 3-450-65902-1.

SWETNAM, R. 2001. Outputs from the NERC Urban Regeneration and Environment (URGENT) Programme: a review.

Chapter 2 Environmental Information in the UK Planning System

2.1 Introduction

In order to define the functional parameters of an Environmental Information System for Planners, it was necessary to:

- understand the UK planning framework (including it's England, Scotland, Wales and Northern Ireland variants, which were found to be broadly similar due to common origins differing mainly in detail, which was taken account of where relevant)
- consider how different users of environmental information within local government both have access to and use environmental information
- determine how environmental information is used to support decision making within development control and development planning functions.

This chapter details the findings of the investigations into the use of environmental information in local authority urban planning.

2.2 Planning Seminar

At the outset a one-day planning seminar led by consultant planner, Andy Arrick from Roger Tym and Partners, was organised to provide an overview of the planning system, and its primary functions. Topics covered included:

- essence of UK planning system
- development plan system
- legal framework
- environmental assessments
- the realities of development

A conceptual model of the planning application process, from submission to decision, was provided (Figure 2.1). This has been used to structure later phases of the consultation process.

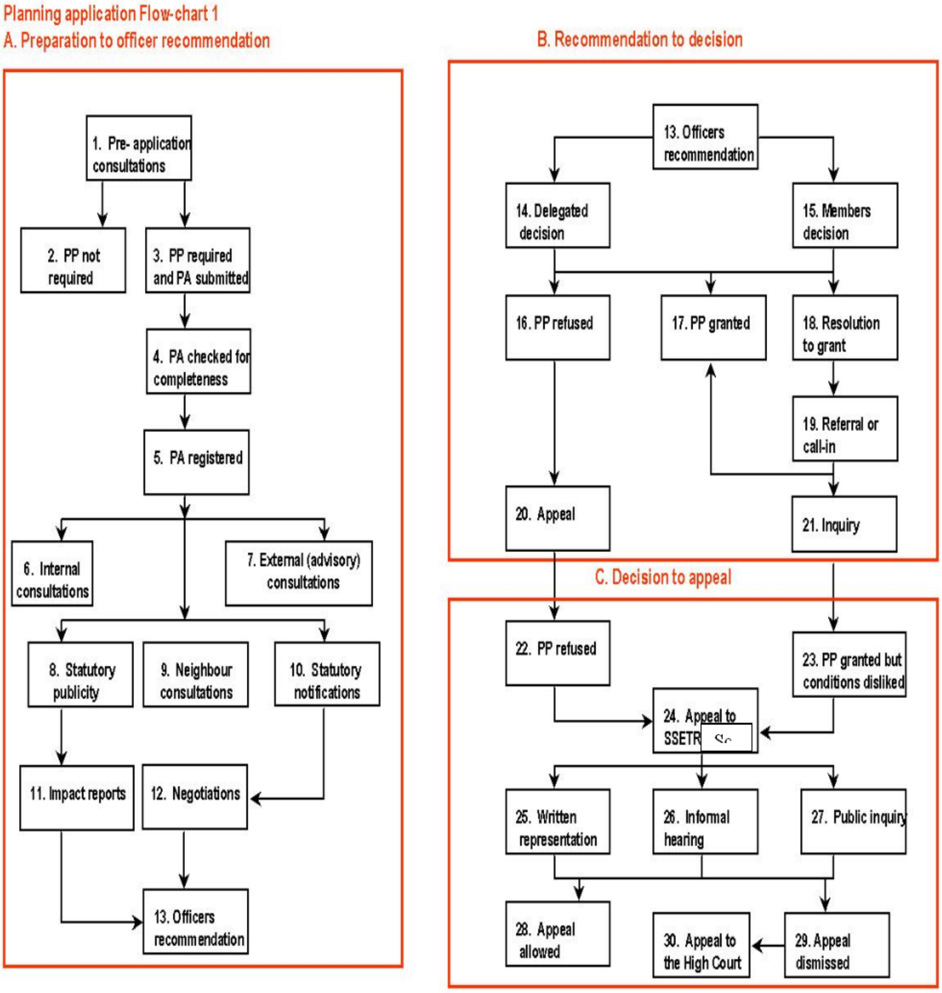

Figure 2.1 Planning process description

Flow charts from an external planning consultancy were commissioned describing the planning application process and these were shown to the local authorities as part of the interview process. Resulting feedback led to minor alterations and the result is represented in Figure 2.1. There are very minor differences in areas such as the appeals process between the English process represented here and that of Scotland but the basic processes are the same.

2.3 Statutory and other drivers

The planning system operates within a legislative framework, supported by statutory regulations and by non-statutory circulars, planning policy guidance and advice. An advice note prepared by Symonds Travers Morgan (Thompson et al., 1998) details the framework documents that are most relevant to environmental planning; further details are given by Alker et al. (2001).

The more recent Planning Policy Guidance notes emphasise local authority responsibilities and include many recommendations on best practice. This information can be combined with local authority decision aids (e.g. flow charts) to begin to assemble the decision rules base for the EIS. Guidance and statutory documents consulted within the initial scope of this research are listed as follows.

Table 2.1 National Planning Policy Guidance in the UK

England:
National Planning Policy Guidance Notes
PPG1: General Policy and Principles
PPG2: Green Belts
PPG3: Housing
Planning Policy Guidance Note 3: Housing
Planning Policy Guidance Note 3: Housing
PPG4: Industrial and Commercial Development and Small Firms
PPG5: Simplified Planning Zones
PPG6: Town Centers and Retail Development (to be released)
PPG8: Telecommunications
PPG9: Nature Conservation (to be released)

PPG10: Planning and Waste Management
PPG11: Regional Planning
PPG12: Development Plans
PPG13: Transport
PPG14: Development on Unstable Land
PPG15: Planning and the Historic Environment
PPG16: Archaeology and Planning
PPG17: Sport and Recreation
PPG18: Enforcing Planning Control
PPG19: Outdoor Advertisement Control
PPG20: Coastal Planning
PPG21: Tourism
PPG22: Renewable Energy
PPG23: Planning and Pollution Control
PPG24: Planning and Noise
PPG25: Flood Risk
Regional Planning Guidance Notes
RPG1: Northern Region
RPG6: Eastern Region
RPG10: South West Region
RPG11: West Midlands
RPG12: Yorkshire and Humberside
DETR Circulars (abridged list)
03/99 Planning requirements in respect of the use of non-mains sewerage incorporating septic tanks in new development.
30/92 Development and Flood Risk
11/92 Planning Controls for Hazardous Substances
17/89 Landfill Sites: Development Control
01/88 Planning Policy Guidance and Minerals Planning Guidance

28/87 Opencast Coal Mining
20/87 Use of Waste Material for Road Fill
15/87 Assessment of Alternative Colliery Spoil Disposal Options
02/99 Environmental Impact Assessment
2/2000 Contaminated Land: Implementation of Part IIA of the Environmental Protection Act 1990.
Minerals Policy Guidance Notes
MPG01 General considerations and the development Plan System
MPG02 Applications, Permissions and Conditions
MPG03 Coal Mining and Colliery Spoil Disposal
MPG04 Revocation, Modification, Discontinuation, Prohibition and Suspension Orders Town and Country Planning (Compensation for Rstriction on Mineral Working and Mineral Waste Depositing) Regulations 1997
MPG05 Stability in Surface Mineral Workings and Tips
MPG06 Guidelines for Aggregates Provision in England
MPG07 The Reclamation of Mineral Workings
MPG08 Planning and Compensation Act 1991: Interim Development Order Permission (IDOs) - Statutory Provisions and Procedures
MPG09 Planning and Compensation Act 1991: Interim Development Order Permission (IDOs) - Conditions
MPG10 Provision of Raw Material for the Cement Industry.
MPG11 Control of Noise at Surface Mineral Workings
MPG12 Treatment of Disused Mine Openings
MPG13 Guidelines for Peat Provision in England, including the place of Alternative Materials
MPG14 Environment Act 1995: Review of Mineral Planning Permissions
MPG15 Silica Sand
Consultation papers
Planning for the Supply of Aggregates in England (31 January 2001)
Planning Policy Guidance Note 14 - Development on Unstable Land: Annex 2 Subsidence and Planning (31st January 2001)

Wales:
Current planning policy document – 'Planning Guidance (Wales): Planning Policy', April 1999.
Followed now by: National Assembly for Wales DRAFT PLANNING POLICY WALES
(Public Consultation – February 2001).
Minerals Policy Guidance Notes:
Minerals Planning Policy Wales. December 2000. 40 pp.
Technical Advice Notes (TANs):
TAN(W) 1 Joint Housing Land Availability Studies (revised) (1997)
TAN(W) 2 Planning and Affordable Housing (1996)
TAN(W) 3 Simplified Planning Zones (1996)
TAN(W) 4 Retailing and Town Centres (1996)
TAN(W) 5 Nature Conservation and Planning (1996)
TAN(W) 6 **Agricultural and Rural Development (2000)**
TAN(W) 7 Outdoor Advertisement Control (1996)
TAN(W) 8 Renewable Energy (1996)
TAN(W) 9 Enforcement of Planning Control (1997)
TAN(W) 10 Tree Preservation Orders (1997)
TAN(W) 11 Noise (1997)
TAN(W) 12 Design (1997)
TAN(W) 13 Tourism (1997)
TAN(W) 14 Coastal Planning (1998)
TAN(W) 15 Development and Flood Risk (1998)
TAN(W) 16 Sport and Recreation (1998)
TAN(W) 17 Environmental Assessment (1998) **- Cancelled by Welsh Office**
Circular 11/99, 'Environmental Impact Assessment'
TAN(W) 18 Transport (1998)
TAN(W) 19 Telecommunications (1998)
TAN(W) 20 **The Welsh Language – Unitary Development Plans and**

Planning Control (2000)
Scotland:
National Planning Policy Guidelines (NPPGs) Statements of Scottish Executive Policy on nationally important land use
NPPG 1 The Planning System (Revised November 2000) **NPPG 2 Business and Industry** (November 1994) **NPPG 3 Land for Housing** (Revised November 1996) **NPPG 4 Land for Mineral Working** (April 1994)
NPPG 5 Archaeology and Planning (January 1994)
NPPG 6 Renewable Energy Developments (Revised November 2000)
NPPG 7 Planning and Flooding (September 1995)
NPPG 8 Town Centres and Retailing (Revised October 1998)
NPPG 9 The Provision of Roadside Facilities on Motorways and Other Trunk Roads in Scotland (March 1996)
NPPG 10 Planning and Waste Management (March 1996)
NPPG 11 Sport, Physical Recreation and Open Space (June 1996)
NPPG 12 Skiing Developments (June 1997)
NPPG 13 Coastal Planning (August 1997)
NPPG 14 Natural Heritage (January 1999)
NPPG 15 Rural Development (February 1999)
NPPG 16 Opencast Coal and Related Minerals

(March 1999)
NPPG 17 Transport and Planning (April 1999)
NPPG 18 Planning and the Historic Environment (April 1999)
NPPG 19 Radio Telecommunications (July 2001)
Planning Advice Notes (PANs) **Advice on good planning practice**
PAN 33 Development of Contaminated Land (Revised October 2000) **PAN 36 Siting and Design of New Housing in the Countryside** (February 1991)
PAN 37 Structure Planning (Revised December 1996) **PAN 38 Structure Plans: Housing Land Requirements** (Revised November 1996) **PAN 39 Farm and Forestry Buildings** (March 1993) P**AN 40 Development Control** (Revised March 2001)
PAN 41 Development Plan Departures (Revised March 1997) **PAN 42 Archaeology** (January 1994) **PAN 43 Golf Courses and Associated Developments** (April 1994) **PAN 44 Fitting New Housing Development into the Landscape** (March 1994) **PAN 45 Renewable Energy Technologies**

(August 1994, currently under revision)

PAN 46 Planning for Crime Prevention

(October 1994)

PAN 47 Community Councils and Planning

(March 1996)

PAN 48 Planning Application Forms

(May 1996)

PAN 49 Local Planning

(May 1996)

PAN 50 Controlling the Environmental Effects of Mineral Workings

(October 1996)

PAN 50 The Control of Noise at Surface Mineral Workings Annex A (October 1996)

PAN 50 The Control of Dust at Surface Mineral Workings Annex B (March 1998)

PAN 50 The Control of Traffic at Surface Mineral Workings Annex C

(December 1998)

PAN 50 The Control of Blasting at Surface Mineral Working Annex D

PAN 51 Planning and Environmental Protection

(March 1997)

PAN 52 Planning in Small Towns (April 1997)

PAN 53 Classifying the Coast for Planning Purposes

(October 1998)

PAN 54 Planning Enforcement

(March 1999)

PAN 55 The Private Finance Initiative and the Planning Process

(March 1999)

PAN 56 Planning and Noise

(April 1999)

PAN 57 Transport and Planning

(April 1999)

PAN 58 Environmental Impact Assessment

(September 1999)

PAN 59 Improving Town Centres (October 1999) **PAN 60 Planning for Natural Heritage** (August 2000) **PAN 61 Planning and Sustainable Urban Drainage Systems** (July 2001) **PAN 62 Radio Telecommunications** (September 2001)
Scottish Executive Development Department Planning Circulars and memoranda
Northern Ireland – 11 Planning Strategy (PPS) and 17 Development control advice notes were also consulted and the Department of Environment NI visited but they could not offer the time to be involved with this research and are therefore no longer referred to directly.

2.4 Consultation exercises

2.4.1 Objectives

As part of this study, a consultation exercise involving five local authorities commenced in Autumn 2000, and was completed in September 2001. This study was set up to determine the use made by local authorities of geoscientific and other environmental information.

The objectives were to inform system design and specification by reference to:

- availability of Information Technology systems in local authorities
- use of environmental databases, GIS and other information systems currently in Local Authorities
- organisation of the planning process within Local Authorities to permit appreciation of the range and generality of approaches.

- Identification of stages in the planning process when the decision support would be useful

2.4.2 Methodology

Liaison and fact finding with local authorities consisted of two phases. The first phase consisted of a questionnaire and interview with senior officers of planning departments, and other associated staff within the five local authorities. At these interviews, copies of local plans, planning procedures and any other related documents were procured.

The second phase of interaction required officers within various departments within the local authorities to complete tabular returns to ascertain:

- the current use (and nature) of environmental information within various local authority departments.
- the key environmental constraints within the planning decision making process, the principle questions used to determine the nature of these constraints and the regulatory or policy reference behind particular elements of environmental issues under consideration.

2.4.2.1 Selection of pilot local authorities

Five Local Authorities were selected to take part in the initial consultation exercise, Figure 2.2.

- Telford and Wrekin Council
- Wolverhampton City Council
- Glasgow City Council
- London Borough of Newham
- City and County of Swansea

The choice of local authorities was determined partly as a result of contacts that had already been developed through existing projects (e.g. Thames Gateway Study (BGS/DETR)). Other considerations were:

- Availability of good environmental datasets
- Access to information technology
- Within individual councils - a positive commitment by staff to the development of a decision aid system.

The selection of two authorities in the West Midlands reflected the considerable level of research, funded under the URGENT programme, which was focused on that region.

All five authorities faceed regeneration problems: the two Midlands authorities and Glasgow City are located on exposed coal-fields and have to deal with a legacy of nearly three centuries of industrial activity, arising from locally available mineral resources of coal, ironstone, brick-clay and limestone. There are natural hazards (e.g. landslides), difficult ground conditions, and a variety of conservation issues (e.g. Telford and Wrekin Council includes the World Heritage Site of the Severn Gorge). The London Borough of Newham lies within the Thames Gateway, and as part of one of the largest major development initiatives in Britain, provides a counterbalance in terms of location, scale, and working practices. The Borough embraces a wide range of ground conditions from contaminated brownfield (Nathanail, 2003) sites to weak alluvial soils, and internationally recognised wetland conservation. The City and County of Swansea, represents an authority with significant issues of land contamination to deal with. The local authority also contains a designated Area of Outstanding Natural Beauty and coastline. In all the local authorities, there was an emphasis on conservation with an acknowledgement in structure plans of the need to protect and conserve the historic, built and natural environment.

Figure 2.2 Distribution of Local Authorities agreeing to take part in interviews

2.4.2.2 Questionnaire and interview

Questionnaires were distributed and interviews arranged with heads of departments. Respondents were asked to comment on the validity of the planning conceptual model (Figure 2.1), and describe their own areas of responsibility.

Specific information was requested to:

- identify working practices across different departments
- chart the procedures involved in determining planning applications
- identify any formal systems or procedural frameworks (worksheets, flow charts) for dealing with specific environmental problems

- assess the use made of expert advice (internal or external)
- assess GIS capability
- assess data holdings (digital and non-digital)
- highlight any aspirations

The preparation meetings were followed by further working meetings at management and work unit levels. This process was slower than anticipated. However, it was recognised that this process of familiarisation with Local Authority systems and practices was very important to the success of the research.

2.4.2.3. Collated results of the questionnaire and interviews

Each local authority visited was asked to provide more specific information to assist the project. And the questionnaire tables were completed by various parties using environmental information within the planning process. These included planning officers, technical specialists employed within council teams, strategic planners, IT officers, estates officers, environmental health officers and building control regulators.

The questionnaire sought to establish how planning constraints are applied in specific environmental areas. Lists of distinct environmental considerations (each with an individual code) were compiled for each of the following environmental areas:

- difficult ground conditions
- groundwater and surface water protection
- flood protection
- air quality
- ecological conservation and bio-diversity
- cultural and natural heritage
- minerals and waste
- amenity
- noise

- water catchment management
- strategic environmental assessment

The last three items were not expressed in earlier interviews as causes that currently concerned the planning function at the local authority level, but were added as they were subject to recent / forthcoming EU directives.

Respondents were asked to state the planning questions (constraint) that they would be required to satisfy for each discrete environmental consideration, divided by land use type, in terms of:

- an overall principal constraint
- residential use
- industrial use
- commercial use
- retail use
- open space use

Respondents were also asked to indicate the regulatory, legislation or policy source of the constraint.

For specific environmental considerations and features, respondents were asked to indicate what environmental information they currently used to inform the planning decision making processes. Details regarding the scale, source and format of the data were also provided. Respondents also indicated whether a specific data set was used in development control or strategic planning, and co-related the data set to the specific coded environmental considerations.

Many returns were received from individuals within the authorities, but no single authority completed a comprehensive set of results. Wolverhampton declined to participate in this exercise.

The detailed results of these questionnaires and interviews are partially masked by the use of letters to differentiate individual councils as the project offered at the interview stage that "The results of this exercise will not be released to a third party without the agreement of the Local Authority concerned."

The raw data returns from the questionnaire and interviews in the form of collated tables and lists are available on the CD (referred to as Figure 2.3) provided at the back of this thesis under the directory name \Use_of_Environmental_Information_by_five_UK_local_planning_authorities and are separated into three appendices that were provided to the later developed functional specification of Duffy et al. (2001). Files in this directory described as appendix A are summary tables of constraints and sources for environmental planning decision making, appendix B is a compilation of current use of environmental information in planning by local authorities visited, appendix C is the Lists of GIS layers as supplied by local authorities visited and the file use_of_environmental_information_in_planning_authorities_questionnaire.doc is the questionnaire used. The full report referring to all files is (Alker et al., 2002) and a summary was presented at UDMS 2002 (Alker et.al UDMS, 2002).

2.5 Use of environmental information within the planning process as revealed by local authority interaction

This section considers the use of environmental information within planning in the local authorities visited as determined during interviews with local authority personnel. Each section presents an overview of the authority, environmental issues in planning control, strategic planning and use of environmental information by consultees (mostly in-house departments) to inform planning decisions.

2.5.1. Planning overview for local authority A

Local authority A is a unitary authority serving a former new town. It is 29050 ha in area with a population of 152 670 and rising. 27% of this area can be described as urban. The local authority can be seen to be pro-development, with a high proportion of development (brownfield) land being available, mostly owned by English Partnerships. They are currently required to commit land for 7500 dwellings.

2.5.1.1. Development control for local authority A

The development control process within local authority A is concerned with improving the environmental quality of the district. The pre-planning process is seen as important activity, where the authority would like to inform applicants regarding environmental constraints at an early stage in the process. All applications are entered into a GIS, which also shows major statutory land designations and other environmental constraints – green corridors, SSSI's, AONB, footpaths, landfills, mineshafts, etc. This facilitates the forwarding of planning enquiries and applications to relevant environmental consultees (in-house and externally) for more detailed appraisal.

2.5.1.2. Development planning for local authority A

Current development plans for local authority A include:

- Joint structure plan 1996-2011
- Local plan 1995-2006
- Waste Local Plan (2011)
- Joint minerals plan (under revision)
- Local biodiversity action plan
- Corporate Environmental Management Plan
- Green Network

In terms of environmental concerns, the Waste Local Plan favours waste disposal to landfill (capacity to 2009) due to negative public perception of incineration. Housing is seen as a key issue for the future, with concerns regarding the development on brownfield land, unstable land, preservation of heritage and conservation of green space. Due to a motorway bisecting the urban area, air quality issues (related to traffic) are also significant.

2.5.1.3. Planning consultation (in-house and externally) for local authority A

Local authority A uses in-house consultation for geo-technical issues, building control environmental health and architects. The geo-technical expertise advises planning regarding proximity to landfill sites, former mining areas, stability of colliery spoil. Landslips are tested on an individual basis. Building control ensures building standards are met, especially advising upon foundation requirements in unstable, undermined or landfilled areas. They also provide information on proximity to sewer services. Environmental health advises planning in terms of air quality issues, contaminated land strategy and Prescribed Processes. Environmental information used to inform Building Control and Environmental Health is not integrated on a GIS, or necessarily available to the planning office. Development control procedures are only documented within the in-house geo-technical expertise function. Architectural expertise is called in at the strategic level, to advise on statutory designations, environmental impact and aesthetics.

Local authority A uses external consultants to inform development control decisions. These include the water authority (who receive a weekly list of applications and advise regarding controlled waters), the Environment Agency and English Heritage who are consulted occasionally. Local wildlife, countryside and heritage trusts are also consulted occasionally. Environmental Impact Assessments are rarely required (>1 per annum) and these usually involve an external ecological consultant.

2.5.2. Planning overview for local authority B

Local authority B is a unitary authority of a metropolitan borough council, within the main West Midlands conurbation. It is 6945 ha in area with a population of 240 900. The majority of the area can be described as urban.

2.5.2.1. Development control for local authority B

Local authority B provide few details regarding their development control process, other than emphasising the importance of responding to pre-planning enquiries, where they do not charge a fee. Planning permission applications are logged within a GIS and then checked against environmental constraints (currently paper-based). These include wall maps for under-mining, landfill and coal gassing sites, conservation areas, etc. Specific ecological concerns included bio-diversity issues such as badger sets and rare flora. They use both internal and external consultees.

2.5.2.2. Development planning for local authority B

Current development plans for local authority B include:

- Unitary Development Plan (1988 – 2001)
- Draft contaminated land strategy
- Bio-diversity Action Plan

Environmental concerns expressed by local authority B focus on land quality issues i.e. landfill, made ground, abandoned coal mining areas, contaminated land and hydrology.

2.5.2.3. Planning consultation (in-house and externally) for local authority B

Local authority B uses in-house consultation for building regulations and environmental services. For buildings regulations the chief concern is development on unstable ground, and provision of suitable foundation structures. Environmental services provide planning checks concerning noise, contaminated land, surface water and air quality. Most of the environmental information to support environmental services is paper based, although they are moving toward an integrated water quality database in the future. Environmental Impact Assessments are rarely required (>1 per annum) and these usually involve environmental services.

Local authority B provided no information on when external consultants are used within their planning processes.

2.5.3. Planning overview for local authority C

Local authority C is a city based local authority. The City's post-industrial renaissance is recognised worldwide. It has 611,440 residents, one third of the population of the larger conurbation that the city serves the largest urban area in Scotland. The city has over 11,000 businesses and is the largest manufacturing centre in Scotland. Home to three universities, and other cultural centres, Local Authority C operates in a vibrant, dynamic city capable of responding to changing needs and meeting the demands of the new millennium while respecting the rich heritage of its illustrious past. Consequently the planning and related functions within the Local Authority are the largest departments considered in this study.

2.5.3.1. Development control for local authority C

Current development plans for local authority C include a new City Wide plan, (2001 –2009) available via the World Wide Web. The plan is divided into three parts, the second part of which focuses on development policies. Other strategic and structural plans are under review for the city.

Within Local Authority C, Development control functions are currently placed within the Development and Regeneration Services (DRS) department. Planning officers provide a lot of telephone advice at pre-application stage, mostly for housing applications. When an application comes in a 'development control consultancy' form is used to allocate topics for checking by the DRS specialists. Environmental issues currently considered include archaeology, flooding, landscape, greenbelt, open space, trees (TPO), environmental impact, wildlife/biodiversity and environmental designation. Currently many of these spatial issues are checked against the DRS ArcView based GIS where many of these issues exist as layers. Local Authority C has standard advisory notes and conditions published August 1999 – which are attached to planning consents.

2.5.3.2. Development planning for Local Authority C

Current development plans for local authority C include:

- City Wide Development Plan (2001-2009)
- Contribution to the joint regional structure plan published 2000.

Environmental concerns expressed by local authority C focus on land quality issues i.e. landfill, contaminated land, abandoned coal mining areas (mine shafts), Air quality (at the strategic level) and Heritage. The regional archaeology service remains as a separate unit within the local authority.

2.5.3.3. Planning consultation (in-house and externally) for local authority C

Local authority C has specific provision in-house in a number of areas of expertise including, geo-technical engineering (as in Authority A), archaeological services, buildings control and environmental health, but the integration of information between these services is poor. The archaeology service has a rich resource of data within a GIS, requesting more detailed site investigations on about 1% of planning applications.

External consultees such as Scottish National Heritage, Scottish Wildlife Trust and the Scottish Environmental Protection Agency (SEPA) are contacted when required. Consultees are documented within a manual. Water management issues are usual referred externally, but currently the authority has in-house expertise seconded by Babtie. SEPA do not actually object to applications on floodplains, only providing recommendations, unlike the Environment Agency (EA) in the rest of the UK, which can object, to planning applications.

2.5.4. Planning overview for local authority D

Local authority D is a two-tier authority, with responsibility at the city and county council levels. As such there were 2 adopted local plans for the area and for the city. As of September 2001 a new Unitary Development plan was available for consultation. This has incorporated the area structure plan.

The council has adopted a Cabinet model of government (2000), which had replaced the former committee based approach. There were 8-10 departments involved in planning / environmental health. This was now being reorganised into a redevelopment department. This involves:

- Countryside services
- Special projects – 6 major projects and inward investment
- Economic Development
- Environment and Health (including cleansing)
- Estates

- Technical Services
- Planning services – Development control and Unitary Development Planning

Local authority D is developing a fully integrated GIS system for use within the strategic planning and development control functions. Wide access is available to a centrally co-ordinated GIS database, with over 200 layers of information relevant to planning decision-making.

The local authority has provided planning permission for the building of 800 houses per year over last 10 years, although population in the area is stable the 'living' patterns have changed. – With people living longer / more single persons / families. Have a rise in second homes in an AONB. House prices are relatively cheap within this authority.

2.5.4.1. Development control for local authority D

Local authority D expressed concern regarding the targets they are required to meet to deal with enquiries and applications. Pre-planning applications need a response within two weeks and local authority D deals with 25/30 pre-application enquiries per week. Responses are conservative, encouraging pre-submission discussion, particularly regarding architectural views and subjective parts of planning policy. Local authority D targets to deal with 75% of full planning applications in under 8 weeks (90% for householder applications). Delegated powers for the planning department are very limited, and where the planning officer raises objections to the proposal the planning committee then takes the overall decision. Local authority D may require as many as four environmental statements / assessments per year, often conducted internally e.g. sea wall by technical services. Environmental issues are addressed within development control with reference to the integrated information on the GIS. In-house specialists from within each of the seven related functions can further explore most environmental issues.

2.5.4.2. Development planning for local authority D

Within local authority D strategic planning and development control functions are fully integrated. The strategic planning manager is part of the corporate GIS group and feeds into the Welsh Assembly working group. This links the strategic planning into the regional network e.g. roads, railways, broad band, utilities, telecoms etc. This is a key structural element.

Development planning within local authority D mainly considers broad areas of housing and retail development - data is stored and retrieved on a GIS, but they have conducted some ‘what if’ examinations of particular data layers. There is an increased emphasis on research and information systems to inform forward planning (along with census data and predictions). For local authority D In terms of housing, they are required to ensure a 5 year supply of housing (and land adequate for housing development). The Welsh Assembly continually audit to determine urban capacities and structural planning, and often use supplementary planning procedures. Key strategic concerns within the local authority with regard to environmental issues include an area of outstanding national beauty, biodiversity, contaminated land and coastal features. Ecological issues are supported by an in house team. An air quality management plan is being drawn up, and considered impacts from transport due to a major motorway bisecting the authority.

2.5.4.3. Planning consultation (in-house and externally) for local authority D

Local authority D rarely uses external consultancy. In house teams for ecological issues, environmental health and buildings regulations provide sufficient expertise to examine any environmental issues that arise when meet the planning requirements for decision making purposes. However all these departments commented that although they had access to the integrated GIS (except buildings control), consultation was often ad hoc – indicating some refinement needed in planning decision making procedures at the development control level.

2.5.5. Planning overview for local authority E

Local authority E is a London Borough unitary authority bordering the Thames and part of the Thames Gateway. With a population of 228,500 (1997) and an area of 3636 Ha this authority has been in existence since 1965. The prevalence of inner city deprivation and a long industrial history now collapsed means that the planning agenda is Regeneration focussed with much brownfield (including contaminated) land being owned and promoted for development by the council.

2.5.5.1. Development control for local authority E

Planning applications are entered into a digital system (Plantek) on receipt. Pre-application enquiries are very important and a note of them is often placed in a property file. Local Performance Criteria mean that getting applications process is very important and 80-90% of applications are dealt with through delegated authority to area officers who must be multi-disciplinary. Due to the regenerative agenda section 106 planning gain is used where relevant. Due to large projects on brownfield sites more than 6 Environmental Statements a year are received. Development control is seen often to be project management. Planning appeals take up a considerable percentage of officer time. There is a development control validation and procedures manual which sets out consultation procedures and includes supplementary planning guidance notes on a number of topics including archaeology.

2.5.5.2. Development planning for local authority E

Current development plans for Local Authority E include:

- Unitary Development Plan adopted June 1997
- A full draft new UDP dated February 2001
- An LA21 agenda Strategy statement: Environment Matters
- Waste local planning is included within the UDP and is managed by the East London waste disposal authority (4 councils working together)

Environmental quality is a key issue for development planning in this authority and this is reflected by the fact that it is the Environmental Engineering Division that does forward planning and produces Area Framework Plans as development briefs. A leisure services division provides ecological information and records and the Environmental Management Services division has a full time Local Agenda 21 officer working on sustainability issues strategically for the council influencing the UDP and waste management planning. There is also Biodiversity Action Plan activity. The Environmental Health division is shortly to produce an Air Quality Management Plan and does air quality mapping.

2.5.5.3. Planning consultation (in-house and externally) for local authority E

Development control officers consult Environmental health division a great deal on issues such as air quality, noise, and contaminated land. The latter division has responsibility for contaminated land regulation along with the chief executive and have created an in-house contaminated land GIS with the BGS. Leisure services and sometimes the external London Ecology Centre are consulted for ecological information. The EA is consulted on flood issues as required. The UDP since 1997 has included indicative flood maps (much of the south of the authority is within the 1:100 year flood plain) and strategic planning issues include the possibility of flood waters coming up through metal contaminated land. There are gassing sites designated as temporary openspace and a sophisticated system of greenspace Green corridor/Green chain/Green walk provision with areas of deficiency in openspace being considered. The London Archaeological Service is available for consultation on heritage issues.

2.5.6. Summary of identified current use of environmental information in planning

The questionnaire and interview exercise showed, in summary:

- Authorities use both paper and GIS based environmental information to assist planning decisions.
- The scale of information used is often variable, ranging from 1:200, to 1:10,000 and national scale data-sets.
- Most authorities are working towards integrating data within a GIS system.
- Many refer to other bodies for specialised data when the need arises, e.g. Coal Authority, British Geological Survey and English Nature. However, all authorities expressed concern at the additional costs associated with acquiring external data.
- Some authorities had a number of admirable data-sets in specific topic areas that was considered to be of particular interest within that authority. These may or may not be the best information in terms of environmental expertise and science to inform planning decisions and this requires further detailed examination. These included:

  - Authority A has good information on heritage issues, and previous studies on land instability issues (in conjunction with the BGS).
  - Authority C has detailed information on heritage issues, including a vacant and derelict land survey. They also have attempted modelling land instability issues, and have good point data for air quality issues.

- Authority D appeared to have comprehensive data to support ecology based decision making in planning. They also have good point data for air quality issues.
- Authority E has a bespoke GIS system (from the BGS) for dealing with contaminated and issues.

2.5.7 Information Technology appraisal of local authorities visited

IT or GIS officers were interviewed at each council to gain a flavour of current and developing IT developments as they might affect the construction and use of an IT based Environmental Information System for Planners.

Many local authorities now possess GIS platforms (RTPI, 2000), and approx. 44% of authorities either have an 'environmental assessment GIS' or are planning to obtain one. In the authorities that the project wishes to work with the main points of relevance are :

Local authority A:

Planning applications are captured on a Workstation GIS as they come in and the GIS is used in the Development control department for a preliminary sift of issues concerning the applications using the GIS layers listed in Appendix C Part 1.There is a site planning history non-map based digital M.I.S. (Management Information System) also. Whilst the in use GIS system is an older brand, the company has been taken over by ESRI (Environmental Information Systems Inc, Redlands, California) which is rapidly becoming the most common GIS system for U.K. local authorities and its file formats being the defacto industry 'lingua franca' format for GIS dataset exchange.

Internet access from the LAN (Local Area Network) was available from officers' desktops where required. The GIS development group has a staff of 5 underpinning GIS developments and data creation and maintenance. Public access to planning via the internet is being developed.

Local authority B:

Again, planning applications are captured in a digital mapping system as they come in and they can be compared against the 100+ data layers available. However, the digital mapping system has very limited true GIS analysis capability and the department is planning to replace it with either an ESRI system or its main competitor MapInfo (whose file formats are quickly convertible to and from ESRI formats). Paper map based systems are currently used predominantly for planning overlay and sifting. There are 22 workstations in the planning domain, one of which at the time of interview had access to the internet.

Local authority C:

Planning applications are entered into a non-map based M.I.S. system (again, this has been purchased by ESRI and will have links to GIS data), however there are 50+ ESRI GIS desktop users used by planners and related officers and over 200 ESRI format GIS data layers available. Planning for serving GIS data over the intranet and potentially the internet is well advanced and a corporate common data model for all GIS data is being created. Corporate GIS data will be served from a central (ESRI based) database server. There are over 130 workstations in the planning domain alone and any of them can be connected to the Internet on request.

Local authority D:

Planning applications are entered into an ESRI GIS based system on receipt. The latter system, MVM 20/20, customized by the company MVM is becoming a common GIS based application entry system amongst local authorities and the EISP will need to 'interface' to such systems without repeating their functionality. However this is simply achieved by the fact the system produces ESRI file formats which can be used without data conversion. There are over 50 ESRI GIS based workstations available to planners and related staff and over 200 GIS data layers to aid analysis. Plans to form corporate GIS datasets served from central databases and to place data on the Internet are at least as advanced as Authority C and there is a definite commitment to ESRI based systems.

Local authority E:

Planning applications are entered on receipt into a digital mapping system with GIS capabilities and there are approx. 300 users of that system. Approx. 160 data layers exist including project specific ones that reside on MapInfo and ESRI project GIS (one of them supplied by a partner in this EISP project).

Plans are well advanced for storing corporate datasets centrally and for developing public access to planning via the internet. It is likely that a developing corporate GIS will be ESRI based. Most desktop PC's have access to the internet by default and most staff have access to a PC. The planning department describes itself as 'enthusiastic IT system piloters'.

In conclusion, whilst some authorities describe themselves as being relatively backward in IT system implementation due to lack of resources, in fact all prospective partners are moving rapidly towards corporate IT based planning systems and tools. Within the life of the URGENT EISP project all the local authorities were able to supply any existing datasets in ESRI formats without difficulty. As a research project URGENT had ready access to all ESRI GIS tools and it is clearly helpful that such file formats can be readily available. It is also clear that all local authorities could house a PC GIS based technical solution and just as easily they could access and use an Internet based 'proof of concept' solution with the latter probably being more manageable in terms of resources, security and central controlled development between the prospective URGENT EISP and Local Authority partners.

2.5.8 Prevalence of environmental considerations for each authority

This section summarises the environmental concerns in specific topic areas that are present in each authority. It should be considered in conjunction with relevant local plan policies (in particular those concerning ‘environment’). Table 2.1 examines each environmental consideration in turn, in order to assess the environmental issues prevalent within each authority. It should be noted that these results are collated from a tabulated return distributed to various members in local authorities, visited within the planning and related functions. The results therefore represent opinion of officers within each local authority. A summary column indicates that authority from the five visited which expresses the most significant issues regarding a particular environmental consideration.

This table enables the identification of key environmental considerations where there is a real or perceived issue at local authority level. It also indicates the authority which should be approached for some specific considerations, but this would be re-evaluated along with other information, particularly that referred to in section 2.5.2 to establish the level of data available to integrate into the prototype EISP. This review is conducted in section 2.6.

Table 2.2 Prevalence of Environmental Considerations for each local authority visited

Environmental Consideration	**A**	**B**	**C**	**D**	**E**	**Authority where issue is expressed as a major concern**
Difficult ground conditions	✓	✓	✓	✓	✓	All have contaminated land. A and B have land instability issues D and E have significant CL issues
Collapse of abandoned mineshafts	✓	✓	✓	✓		Problematic in B
Collapse of natural cavities				✓		Minor issue
Contaminated land (as in s57 EPA 1990)			✓ Access to info difficult	✓	✓	C has two sites where chromium is an issue D has sites with heavy metals / toxic waste

Environmental Consideration	**A**	**B**	**C**	**D**	**E**	**Authority where issue is expressed as a major concern**
						problems
Land contamination	✓	✓	✓ Access to info difficult	✓	✓	B suggests their CL issues are predominant D has characterised all CL sites
Landslip, rockfall, scree	✓ Ironbridge			✓ Morriston		
Natural subsidence						N/A
Settlement, compressible deposits						N/A
Shrink-swell clay						N/A
Subsidence over shallow mine workings	✓	✓	✓	✓ Morriston		B and D expressed this as significant
Tunnels and culverts	✓					
Natural land contamination				✓		
Groundwater and surface water protection		Rising water table?		✓ No detailed info		Generally a limited response from authorities visited
Effluent and sewage	✓	✓				
Pollution risk					✓	
Proximity to a major aquifer						
Proximity to a minor aquifer						
Proximity to water courses					✓	
Water abstraction point	✓					
Flood protection	Flood records and control measures	✓	✓	Barrage on river Inundation	50% of borough downstr eam of	Generally a limited response from authorities visited

Environmental Consideration	**A**	**B**	**C**	**D**	**E**	**Authority where issue is expressed as a major concern**
				by sea	Thames barrage	
High flood risk area	No info on local flows	A single undev-eloped area	✓		✓	
Low flood risk area					✓	
Medium flood risk area				✓	✓	
Flood prevention	✓			Sea defences	✓	
Land Drainage	✓	✓	✓	✓		
Air quality	✓No details yet	No information	Quite detailed	Comprehe nsive	They consult air quality	D air quality data is detailed, with some modelling
Acid deposition				✓		
Ammonia						
1, 3 Butadine				✓		
Benzene				✓		
Carbon Monoxide			✓	✓		
Dust				✓	✓	
IPPC requirements				✓		
Lead			✓	✓		D also has arsenic / bismuth
Nitrogen dioxide			✓	✓		D has specific problems
Odour					✓	
Ozone			✓	✓		
PAH's			✓	✓		
Part II A processes				✓		
Pm10 hotspots			✓	✓		D has specific problems

Environmental Consideration	**A**	**B**	**C**	**D**	**E**	**Authority where issue is expressed as a major concern**
Smoke					✓	
Sulphur dioxide			✓	✓		
Transport corridors / nodes			✓	✓		D and C have specific problems
Ecological conservation and biodiversity			Nothing specific on bio-diversity		Develop ing	D has mapped 30% of urban area as 'important for nature'.
Designated Areas	✓		✓	✓	✓	D: Gower AONB
Green Belt			✓	✓	✓	All authorities have some greenbelt
Hedgerows	Green network			✓		
UK BAP Habitats	✓	✓	✓	✓		
UK BAP Species	✓	✓	✓	✓		
Red Data Book Species		✓		✓		D large number listed species
Tree Preservation orders	✓		✓	✓	✓	
Geographical context			✓	✓		D – unique diversity of landscape
Cultural and natural heritage	Under review	Poor information				B suggested that their nature conservation, heritage and archaeology was an area that they could respond to comprehensively.
Ancient monuments			✓		✓	
Architectural significance	✓		✓		✓	
Conservation areas	✓	✓		✓	✓	
Historic battlefields			✓			
Historic parks and gardens			✓		✓	

Environmental Consideration	**A**	**B**	**C**	**D**	**E**	**Authority where issue is expressed as a major concern**
Listed buildings	✓		✓		✓	
Sites of archaeological interest		✓	✓		✓	C has medieval and industrial sites in the city centre
Sites of historic interest			✓		✓	
Sites of industrial heritage	✓	✓	✓			
Sites of natural / historical significance	✓	✓	✓	✓	✓	
SSSI's	✓		✓	✓		
Visual intrusion	✓					
World heritage sites	✓					A = Ironbridge
Minerals and waste						
Effluent						
Hazardous substance control			✓	✓	✓	D has 2 CL toxic sites– PCB's, Acids, Tarry wastes etc.
Man-made cavities		✓		✓ Bell pits		
Proximity to closed landfill	✓	✓	✓	✓		
Proximity to derelict minerals extraction facilities	✓	✓		✓ and smelting		
Proximity to operational landfill	✓	✓	✓	✓	✓	Equally problematic for all authorities
Proximity to operational quarries	Open-cast mining			✓		
Unstable spoil mounds	✓					
Resource	✓			✓		

Environmental Consideration	A	B	C	D	E	Authority where issue is expressed as a major concern
extraction						
Risk assessment						
Siting of waste management facilities			✓		✓	
Landfill gas	✓	✓	✓ Recover y	✓	✓	
Mine gas						
Radon	✓			✓ Further work needed		Response generally poor
Noise	Being mapped					
Aircraft noise					✓	
Industrial noise					✓	
Landfilling operations					✓	
Railway noise					✓	
Road traffic noise	✓				✓	
Sporting activities					✓	
Water catchment		✓				
Strategic environmental assessment (economic and policy)						
Agenda 21	✓		✓		✓	
Economic benefits					✓	
Regeneration				✓	✓	
Renewable energy						
Reuse of derelict or brownfield land			✓			C has current vacant and derelict land survey

Environmental Consideration	**A**	**B**	**C**	**D**	**E**	**Authority where issue is expressed as a major concern**
Sustainable development	✓		✓	✓	✓	
Tourism				✓		
Traffic considerations				✓	✓	
Transport issues				✓		
Other						
Allotments			✓		✓	
Childrens Play			✓		✓	
Green / Open space			✓		✓	
Parks and Amenity Open Space			✓		✓	
Sports Play			✓		✓	
Drainage and Sewers	✓					
Coastal protection				✓		D has issues of sand dredging and sea defences

2.6 The potential use of an Environmental Information System for Planners (EISP) within local authorities visited

2.6.1. The position and responsibilities of local authority planning departments

Local authority planning departments control development in their areas, ensuring that any proposed development or change of use is determined in accordance with the provisions of the Town and Country Planning Act 1990, other legislation and planning guidance. They are also responsible for forward planning that is, the planning, monitoring and management of the requirement for housing, economic development, etc., which will be required over a specific plan period of up to 20 years.

In order to apply national planning guidance many local authorities produce a list of local plan policies that are applicable in their area, against which planning enquiries and applications are checked for compliance. In environmental terms these include policies concerning natural conservation, heritage and tourism, transport, building on flood plains, development near to landfills and a host of other environmental considerations. Often, environmental policies are principally the concern of other departments within a local authority, such as the estates department, environmental health and buildings control. For example, air quality management and building on contaminated land usually involve specialists from environmental health. Where authorities have a known environmental consideration of particular concern, the authority may also have a specialist team in-house to provide advice. If internal advice is not available external technical advice is sought, such as consultation with appropriate agencies, particular in terms of heritage issues and water.

Each planning application therefore needs to be checked by the planning officer against a wide range of environmental considerations. Only when all the evidence is gathered, examined and determined is the planning officer (and committee) in a position to grant planning permission, apply conditions to a proposal, or reject a planning application. This decision making process is complex, but most authorities endeavour under ‘best value’ targets to decided an application within eight weeks of receipt. Clearly if the planning officer needs to consult expertise external to the authority these time scales can be difficult to achieve. This research has also found that internal consulting processes in most authorities can be problematic, particularly where different departments are separated in terms of geographical location and where information used to determine environmental considerations is not integrated between departments. This later point is illustrated by the finding that in three out of five local authorities visited, the planning office did not have access to data in order to verify any internal or external advice, and effectively had to rely on his/her own experience and the consultants conclusions.

Forward planning and the construction of strategic plans in terms of this research, combines local environmental information with national guidance and predictive urban capacity studies. The resultant allocation of land uses within certain areas within the authority is designed to meet the future needs in economic, social and environmental terms for the authority. Emphasis within forward planning has historically been placed upon housing, economic development and infrastructure However, some authorities (and the Planning Green Paper DTLR, 2001) are recognising the need to give more consideration to particular environmental considerations within this process e.g. flood risk and open space policies.

Specialist teams operating parallel to the development control function within the local authority often produce the strategic plans. These rely upon the information used by development control and provided by other in-house departments to compile spatial representations of the area, for different considerations e.g. maps of open spaces, green corridors, conservation areas etc. Four out of five of the authorities visited currently produce this information manually. It was found that occasionally information is bought in to assist this process from national agencies e.g. English Heritage, English Nature etc. Gathering the information required within the strategic planning process and amending this to illustrate the constraints of national planning guidance in a local context (via local plan policies) appeared to be a lengthy process in all authorities visited. Amendments in policy that occur within a plan period also appeared to require a major revision exercise to the strategic plan.

2.6.2. Technical and environmental expertise within the local authorities

Technical advice on environmental issues is provided to the planning decision process from a range of functions, either within or out-sourced from the local authority.

Of the five authorities visited:

- One Authority had in-house technical expertise available on ecological issues.
- Two Authorities had in-house technical expertise on heritage issues
- Two Authorities had in-house technical expertise on air quality issues.
- Three authorities had in-house technical expertise in geotechnical issues (including landfill, land contamination and land instability)
- All authorities had buildings control regulatory expertise, but all relied on developer reports for compliance, health and safety issues.

Where authorities had available in house expertise, this was usually in response to significant issues in these areas being of concern within that local authority related to the planning process. For example, the authority with an ecological team also has an Area of Outstanding Natural Beauty within its remit.

Technical advice was usually provided in the form of:

- Comments on existing consultant reports, as supplied with the planning application by the developer.
- In house reports compiled for council owned land developments.
- Reference to and compilation of strategic plan policies such as the Waste and Minerals plan or Air Quality Management Plan was often the remit of the in-house technical advice team.

Environmental topics covered at present by the planning processes are related to available PPG's and other EU directives. It is anticipated that with new EU directives in related topic areas, new information may need to be integrated within the planning decision process. All authorities used information related to planning decision making in the areas of:

- Difficult ground conditions
- Groundwater and surface water protection (some relied on EA/SEPA advice)
- Flood protection (all relied on EA/SEPA advice)
- Air Quality

- Ecology
- Heritage
- Minerals and Waste (particularly at the Strategic Planning level)

It should be noted that all authorities visited did not yet use information concerned with Noise, Water Catchment Management or Strategic Environmental Assessment, but were aware that they may soon be required to do so.

In general most technical advice, either from in-house teams, or external consultants (including those provided by the applicant) was taken as being correct and the recommendations therein were followed by the planning team. It was apparent that many planning officers had insufficient expertise in environmental considerations to be able to fully understand or interpret the reports, most simply referring to the 'expert' conclusions to inform the planning decision. This is partly due to the planning officers own lack of access to detailed information held in many authorities due to un-integrated records. It is also affected by a lack of simple procedures and guidance related to environmental concerns in planning decision making, which would allow the (inexperienced) officer to understand the planning decision process required for particular environmental concerns.

All local authorities visited have reported instances where expert advice on environmental considerations is ignored in the light of other strategic or economic considerations. This is not acceptable if the Local Authority is proceeding to achieve best value targets for such aspects as Air Quality and Sustainable Development. Similarly, use of inappropriate data due to a lack of resources may have led to poor planning decisions being made. An issue that has also arisen stems from late allocation to some technical expertise, and non-receipt of an appropriate response within the time limit allocated. All authorities were able to report at least one incident of where inappropriate data or 'time-out' had led to an unfavourable (in environmental terms) planning decision having occurred.

Of the five local authorities visited, all planning departments had IT capability and Internet access. However, access to GIS based information varied widely. Where GIS was available it was often available in separate or dedicated (and sometimes incompatible) systems related to specific departments, particularly where Environmental Health departments provided advice to the planner.

One local authority is currently implementing a fully integrated Geographical Information System available to all departments concerned with the planning decision process. It appeared that other authorities are moving towards this. Another authority visited relied principally on paper based information for environmental planning decision making. Most of the local authorities visited had compiled over time a GIS or paper databank sufficient to answer around 80% of the planning related decisions required without difficulty. Where in-house information was not available, it was found that most authorities relied on the developers report / local knowledge and expertise to satisfy any queries. Where specific environmental problems were anticipated or were significant within a local authority, additional environmental information was resourced. Many authorities commented that they lacked resources and guidance to revise their data in specific environmental topic areas.

Quality procedures within the planning office were often in the form of a simple allocation checklist, although most planning offices had electronic tracking facilities to lodge and allocate planning proposals to specific departments for advice. Only one authority visited was moving to document procedures in terms of flow charts for their internal processes, but this was viewed from a workflow rather than information flow perspective. It was also apparent that few of the authorities visited were aware of process flow documentation available from the IDeA, however, examination of this information by the EISP project team suggests that this presents more of an overview to processes. Similarly most in-house technical advice was prepared against a ‘standard’ checklist, although some specific departments relied upon an employees’ experience and expertise, with the process being undocumented in any way.

2.6.3 Problems faced by the local authorities

Discussions with personnel from the five local authorities visited suggested that there were four major areas of concern facing the effectiveness of planning decision making in the future. These were:

- Internal liaison between departments and the sharing of environmental information and data is a major issue for all authorities visited. However, the project team has seen some evidence that response to this issue is clearly facilitated by the use of an integrated data system.
- The dynamic nature of planning guidance in relation to the strategic plan period. Many policies have to revised within the life of the strategic plan as Central government reviews all planning guidance more frequently than in the past, whilst providing additional guidance on environmental topics not previously considered within the planning process e.g. PPG 25, July 2001 Flood Risk. These reviews incorporate new principles into the PPG's, such as 'sustainable development', 'best practicable environmental option' and the responsibility of the local authority to be able to respond to 'dynamic changes' in national policy caused by new legislation and EU directives. Many authorities are only now beginning to address the effect of these new principles within the strategic planning process, under their own plan review structures / periods. Until local policies are decided at the strategic planning level they will not be considered fully within the development control function.
- Best value and added value. The performance of local authorities is rated by central government by a number of measures one of these being 'Best Value. As a public office it is the responsibility of the local authority to provide best value to its clients i.e. us the taxpayer. It must demonstrate that it is providing best value by setting targets in all areas of council function (some of which have been assigned nationally) in order to show that its services are providing for the sustainable future of the area. For example, Swansea City and County Council has set a list of best value performance targets in environmental terms for the following areas:

- Making Swansea healthier e.g. Reducing the incidence of high pollution episodes by 200% by 2005
- Increasing prosperity in Swansea e.g. To complete the development of our major projects by the programme dates and with regard to the principles of sustainable development
- Cleaner Air – production of a Air Quality Management Plan within 12 months

Best value is also related to individual departmental performance, for example within planning, deciding all planning applications with 8 weeks.

As discussed many local authorities also provide a level of expert advice in environmental areas, from in house technical expertise. These departments increasingly have to demonstrate their added value and worth to the planning function i.e. would it be cheaper to consult externally rather than provide an internal facility. Quicker internal access to the best environmental information is needed to ensure that these departments can continue to provide a competitive service. Loss of these internal services may result in poor planning decision due to the inability to verify information from external sources.

Most of the authorities visited suggested that the cost of environmental information and expertise is often prohibitively expensive for a local authority to meet, particularly in terms of digital data. Limited budgets coupled with time constraints on decision making can mean that authorities only refer to information at hand, some of which is extremely outdated and poor. A large number of decisions are still based on paper records, which take considerable time to collate and interpret. Most authorities would welcome the ability to be able to source the most appropriate digital data related to the planning decision, but lack the knowledge of what data could be available. It was suggested that with an increasing amount of environmental issues to be considered in the planning framework, many authorities would be unsure of where to seek appropriate advice and that this presents a major challenge in new topic areas.

2.6.4. The ability of each authority to contribute to an EISP prototype

Visits to the local authorities showed that, of the five authorities visited some had specific environmental considerations that were supported by an in-house technical team, whilst other environmental considerations may be found in any authority.

- Technical expertise was available in-house for ecological considerations in Swansea, and to some extent in Glasgow and Newham.
- Technical expertise was available in-house for air quality considerations in Swansea and Glasgow.
- Technical expertise was available in-house for ground condition considerations in Telford and Wrekin, Glasgow and Newham.
- Technical expertise was available in-house for heritage considerations in Telford and Wrekin, and Glasgow.
- Technical expertise was available in-house for buildings control regulations in all authorities.

Environmental considerations were also highlighted in some authorities and not in others. For example, Swansea had particular interest in ecological issues due to a responsibility for an Area of Outstanding National Beauty, coastline and extensive green corridor network. Telford and Wrekin's remit includes a World Heritage Site at Ironbridge Gorge and responsibility for developments within part of the Severn flood plain.

In order to produce an EISP prototype it was not only necessary to be sensitive to individual local authorities' specific areas of environmental concern and expertise, but to also consider the availability of in-house digital data and resource implications when liaising between individual local authority departments. In addition the EISP research project's own resources suggest that it would be impossible to source all the data for all environmental considerations in all authorities visited, in the time-scale left to project completion.

Both the local authorities and the research partners needed to consider the exchange of data as confidential and not make that data available to sources outside the project, except as previously agreed for demonstration purposes. All sources of data will be acknowledged in reports and other dissemination from the project. Protocols for data security and access will be established.

Some local authorities present areas of specific environmental concern that are not necessarily encountered within all local authorities. The aim of the research was to provide a generic prototype that illustrates ‘proof of concept’. Therefore the prototype may endeavour to examine some of these special concerns, but may not be able to provide a full interpretation of a situation in terms of the planning decision required i.e. expert advice or consultation may still be needed for any given planning application. Data gaps may also result in EISP being unable to progress past certain points in the decision process. However, it is hoped that in such circumstances the planner would be directed to better information and science than that which is currently used in the decision process and that s/he is able to verify the level of information returned by the external consultant using EISP.

2.6.5. The potential benefits to the local authorities of EISP

Discussions with the five local authorities concluded that a prototype EISP could contribute to local authority best value performance targets by:

- Identifying environmental concerns that are an issue with each planning enquiry or application.
- Enabling rapid allocation of planning applications to appropriate personnel or consultants for technical advice on areas or environmental concern, maximising response time.

An EISP could benefit the local authority by providing added value in terms of:
An electronic checklist to support QA procedures indicating issues of environmental concern for a particular application along with the decision questions and the data interrogated during the process.

Rigorous and documented procedures for environmental decision making on planning issues, with the potential to be accessible (in the future) in-house, to committee and the public. This would enables transparency within the local authority planning function.

Documented procedures (flow charts) coupled with environmental information tied to specific planning decision questions would also assist and guide less experienced members of the planning team as well as officers who have little knowledge of the nature and relative importance of environmental information.

An EISP could benefit the local authority planning decision making process by:

- Providing information as to the best data available against which to make any planning decision or local plan policy.
- Giving clear links including contact details for appropriate external organisations/ consultees to advise on specific environmental issues.
- Direct the planning officer or strategic planner to recent scientific work, including research and modelling, in areas of environmental concern, which my be relevant and could be applied to specialised issues within individual planning applications, or that need to be investigated during the development planning process.

And finally an EISP could augment integration strategies within local authorities by:

- Combining environmental information within one source point accessible by all departments.
- Encouraging the participation of all holders of environmental information within the local authority in the planning process.
- Highlighting and allowing the interrogation of related environmental issues, so that a balanced approach could be achieved in planning decision making.

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Chapter 3 Decision Support Systems in the planning domain

3.1 Scope of review

The review covers both fully operational (applied) systems and demonstration / research systems. Examples are drawn from each of the main environmental discipline areas listed below:

- Ground stability
- Natural contamination
- Contaminated land and landfill,
- Surface water and flood hazard
- Groundwater protection
- Land use planning and ecology
- Air quality

Geographically, the focus is restricted to the UK, but where international datasets or research are applicable to the UK situation, they have been included.

3.2. Decision support systems – definitions and characteristics

3.2.1 Definitions and terminology

The terminology used in discussions about information, knowledge and decisions is often confusing. Some of this confusion is caused by attempting to classify systems on the basis of the complexity of the techniques employed. This project needs to develop a system to provide practical help to a clearly identified user - in our case, the local authority planner. Therefore, we choose to distinguish Management Information Systems, Decision Support Systems (DSS), and Expert and Knowledge

Based Systems only by their intended use. These issues are discussed at length in texts on DSS and expert systems, whether from an environmental perspective (e.g. Hayes-Roth et al., 1983; Gray and Stokoe, 1988; Wadsworth, 1995), or from a more general viewpoint (e.g. Bennett, 1983; Sprague and Carlson, 1986; Turban, 1988; Curtis, 1998).

While acknowledging that a continuum exists, we adopt the basic definitions:

Management Information Systems

- provide information and data to the user

(Has X happened?),

Decision Support Systems

-estimate the implications of a particular course of action

(What if X happens?),

Knowledge Based Systems

- tell the user what to do

(When X happens do Y).

It should be emphasised that the complexity and sophistication of the system is not strongly correlated with its intended use. Management Information Systems can employ complex data mining techniques, artificial neural nets, and high level statistics; yet, an Expert System can be defined as a very simple set of decision rules.

Organizational culture and decision makers

Development of a useful (rather than merely usable) DSS requires an understanding of the context of how people and organizations make decisions. There is an extensive literature on this subject but two ends of the spectrum are (Simon, 1976; Cyert and March, 1963):

Rational economic man

-has a complete and consistent system of preferences, is always aware of all alternatives and has no limits to the amount of complexity that can be processed, whereas

Administrative man

-suffers from 'bounded rationality', looks for relevant and crucial factors in the hope of finding a satisfactory, rather than optimal solution.

We believe that ‘administrative man’ is the more realistic view.

Our user is going to be using three facilities when making decisions (Newell and Simon, 1972):

Intelligence (making comparisons, identifying exceptions, computation),

Design (developing alternatives) and

Choice (evaluation and selection).

Our DSS needs to assist each of these three processes, possibly in an interleaved and iterative fashion.

In addition, any decision system needs to ensure that the output generated is meaningful. ‘Administrative man’ often needs to be able to justify his decision (e.g. this decision was made to comply with statutory regulations). If the decision making process has become semi-automated, through use of a computer system, then not only does the process need to be transparent, but the output may need further interpretation. Input data and output results have to be meaningful and representative of the scenario under consideration.

A distinction can also be made between the following terminology:

Decision support aids

- provide information and structure to the decision support process. Such aids include map-based information and reports , statements, and guidance Procedural aids are commonly presented in the form of check-lists and flowcharts.

Planning support systems

- are geographical information and spatial modelling systems, which are primarily developed to support planning processes both in terms of derivation and evaluation of alternatives (Geertman and Stillwell, 2001).

Simple decision systems can be paper based, as in the form of a flow diagram. However, within the planning framework, decisions are seldom clear cut and require careful evaluation of alternative options. Therefore most decision support systems require a computer base to process the information, but ultimately rely on the experience of the human ‘planning’ computer (the brain) to predict viable alternative outcomes.

We therefore believe that planners require more than an information system, and less than an expert system. Planners are the legitimate authority in this process in the sense they make recommendations which are then approved or rejected by council, hence, our deliberate use of the term Decision Support System to describe the system we propose to build.

3.2.2 Characteristics of Decision Support Systems

Sprague and Carlson (1986) define a DSS as a ‘computer based system that helps decision makers confront poorly structured problems through direct interactions with data and analysis models.

Carlson (1983) gives the following conceptual framework for a DSS:

- Specific representation to assist in the conceptualizing of the problem and to provide a frame of reference for using the DSS. (In other words, we must understand the current planning process and tailor the DSS so the user understands what the DSS is trying to help with)

- Operations on the representation to support intelligence, design and choice activities in decision-making. (That is, the DSS must allow for every stage in the decision-making process).
- Memory aids to support the use of representations and operations. (The DSS must account for the human side of the process).
- Control aids to help the decision-maker control the representation, operation and memory aids.

In practice, Carlson's elegant framework is usually reduced to a few standard pieces of technology:

- a graphical user interface (GUI) which is more (or less) intuitive
- a few help pages, which may or may not be context specific
- a relational database over which the user has limited control; they may be able to add data or edit a standard query but they are unlikely to have access to the basic structure
- probably a model or two over which the user has limited opportunity to alter a few of the input parameters, and almost certainly no control over how it is conceptualized or implemented
- possibly access to a limited set of functions found on a Geographical Information System (GIS)
- some graphical output, and,
- an automatic report generator

More recent developments in the use of Geographical Information Systems, using PC-based applications such as ArcView and MapInfo, have given local authorities wider access to simple decision aid techniques. GIS platforms now exist in in 65% of UK authorities (RTPI, 1995). A basic level of training can allow the operator to manipulate the data to produce modelling features such as distance buffers. A higher level of skill can produce small systems tailored to specific decision aid requirements i.e. where data are integrated to produce a prioritised representation. This is illustrated spatially in many local authority deposit plans. More complex systems are not generally available to the planning end user.

3.2.3 Why aren't DSS more widely used?

Most DSS fail to be adopted by their intended users. Such failure is rarely reported despite the vast literature on the subject.

Problems can be broadly considered under three headings:

- Contextual
- Resources
- Technical

Contextual issues include such things as:

-legitimacy (who has the right to make the decision?)

-accountability (who ‘carries the can’ if it all goes wrong?)

-resistance to change within an organization, and.

-accessibility.

The contextual issues are highlighted in papers by Foran and Wardel (1995), Davies and Medyckyj (1996), Gobbin (1998) and Imperial (1999). The difficulties are summed up succinctly by Hyman and Stiftel (1988) who observed that ‘most environmental controversies are over whose value judgements are represented in decision making and how diverse interests are to be reconciled, rather than being about scientific issues’.

Implementation of a decision support system with an ‘accessible’ programmable interface, which can cope with subjective judgement and objective information is often not straightforward. Several questions need to be considered:

To whom should the system be accessible?

- What subjective and objective information needs to be incorporated?
- How should ‘value judgements’ be measured?
- What decision framework needs to be incorporated?
- What ‘margins’ are there in the decision making process under consideration?
- How much should / could the operator be allowed to program variations into such a decision system before the system loses its robustness?

Therefore when DSS are designed for an end user, there are many issues of appropriateness that have to be addressed. Current attempts to design DSS often focus on a specific issue or set of clearly defined decisions, which make it a relatively straightforward process to establish the limits of such a system. This may be adequate for a research-based DSS, which is where most examples exist. It does not always translate to a ‘real world’ scenario, such as planning, which involves a multidisciplinary perspective, with poorly defined boundaries.

Resources

Lack of resources is reported as the principal reason for the poor uptake by local authorities of computer-based systems.(RTPI, 1995).

- Resources are required to:
- acquire and implement a new system
- train staff
- overcome organizational biases
- update and maintain databases
- inform users of changes
- cover the increased workload while a change over is made
- obtain new and additional data sets.

A ‘rule of thumb’ for commercial software is that it costs at least as much to implement a new piece of software as it does to purchase it, a fact forgotten by most organizations. GIS software, which provides local authorities with the basis of a spatial DSS, is relatively cheap at about £1000 per workstation. However, the costs of data procurement, particularly the cost of researching and securing local relevant data, is prohibitively expensive for most authorities. During the recent National Land Use Database Phase 1 exercise (DETR, 1999), 20% of local authorities failed to provide land use returns, mostly due to a lack of resources to gather the information.

Graafland (1999) estimates a minimum of a decade to fully implement a GIS in a medium-sized (Dutch) local authority (and longer in very small or very large authorities). The RTPI (1995) confirms this estimate, indicating that many UK local authorities may have only one or two GIS workstations. The real issue here is an organisational one, with authorities failing to tackle data integration and computing on a corporate basis.

The training of planners, particularly at undergraduate level, has only recently (over the last 5-10 years) included use of GIS and other computerised systems. Until there is a wider appreciation of the use of these tools for analysing options across a range of issues (social, economic and environmental), emphasis will continue to be placed on ‘value’ judgments.

Technical

Technical issues are probably less important than resource and organizational constraints, but can include many issues:

- Data availability
- Accuracy (and precision) of data
- Accuracy (and validity) of modelled outputs
- Currency of data (and conceptual models)

- Usability of the system.

Or simply the system may be too difficult to use, especially as the designers are not the users. Hix et al. (1994) note that ‘without a clear statement of requirements for the user interface of the system, this control may be lost from the beginning. Further, the cost of interactive system usage is especially significant in the case of contracted-out development, because the customer - the organization that lets a contract for interactive system development - bears the costs of training and poor user productivity'

3.3 Elements of a Decision Support System for planners

Local authorities formulate policies and determine planning applications within a complex set of statutory regulations designed to control the development and use of land in the public interest. This section focuses on the controls that are relevant to environmental planning within English unitary and two-tier authorities. It should be noted that since devolution Wales, Northern Ireland and, in particular, Scotland may differ slightly in terms of legislation and regulation. These differences are not covered here, but are relevant to the overall design, if the system is to be applicable in different parts of the UK.

3.3.1 What is Environmental Planning?

For the purposes of this research ‘Environmental Planning’ means those strategic and tactical decisions that impact on, or are affected by, the physical environment. The decisions are influenced by:

- The UK planning framework
- Planning control and the regulatory framework
- Guidance (both documented and experiential)
- Reports that include environmental information

Each of these elements is discussed in more detail below.

3.3.2 The UK planning framework

Planning functions and responsibilities operate at a number of levels. Government provides the regulatory framework for planning, through Acts of Parliament, national planning guidance and other relevant advice. It also approves the Structure and Local Plans, or Unitary Development Plans (see below). When these are approved, they remain ‘on deposit’, and all planning decisions should accord with these plans (Blackhall, 1998).

At a strategic level, both central Government principally through DETR, and Regional Development Agencies (RDA’s) may designate areas for strategic uses and thereby influence planning. This particularly applies to such examples as infrastructure, defence establishments etc., and where major inward investment is sought for economic development and regeneration (e.g. enterprise zones) .

Environmental information may be used in both policy making, and for determining regional strategies such as, for example, implementing environmental management strategies over large areas such as National Parks, or water catchment management.

Planning control of land use is chiefly the responsibility of the local authorities, who are required to:

1). Produce a development plan, which once approved by central government is a blueprint for development of the whole area for at least the next 10 years (DETR, 2000a). These development plans consist of:

- Structure Plans These concentrate on key land issues and comprise information describing the physical, economic and demographic composition, and infrastructure of the whole authority area. They may incorporate details of strategic importance, existing policies and regimes and special features e.g. Urban Development Corporations.
- Local plans (‘shire counties’): These list relevant statements and policies for the development and use of land in the local authority area; they include maps which may illustrate development allocations.

- Unitary Development Plans (metropolitan districts): These incorporate the requirements of structure plans and local plans in one document.

2).Produce other planning documents such as the Minerals and Waste Plan (often produced at county level). These detail mineral extraction, both above and below ground, subject to the Town and Country Planning Act 1990, and other conditions or restrictions- such as strategic mineral reserves and existing rights to work minerals (which are granted for a period of 10 years) (DETR 1998a). Historically, the waste from mineral extraction has either been deposited on the surface of the land in spoil heaps, and, in some cases, later used to fill any resultant void. Landfill of other waste materials, particularly household refuse, has also been used to reclaim land – therefore the Minerals and Waste Plan not only includes extraction, but also waste disposal and reclamation strategies.

3).Provide planning permissions for (re)development that accords with the development plan, and ensure that these meet all statutory and regulatory requirements, as laid down by s54A and s70 of the Town and Country Planning Act 1990.

The above functions may draw on expertise from different departments or organisations. They may also have to consider broader strategic objectives such as Objective 1 status within the EU.

Environmental impact reports provide a mechanism for local authorities to weigh up the likely affect on the environment of certain types of development proposals.

An Environmental Impact Statement is an assessment of environmental effects of a project on human beings, flora and fauna, soil, water, air, climate, landscape, material assets and cultural heritage (Town and Country Planning Regulations. 1988 (SI 1998/764) (DoE, 1988). It identifies, describes and assesses the above aspects (and how they interact). A developer usually asks the planning authority whether an environmental impact statement is needed. They are always required where a project is likely to have a significant impact on the environment. In order to assess this likely impact, local authorities often request an Environmental Statement at the planning application stage of any development. This provides descriptive details of environmental information,

An Environmental Impact Assessment is a process that examines the environmental consequences of development actions in advance. It is systematic and holistic and involves multi-party participation, especially the community. It may be conducted to form an Environmental Impact Statement, particularly for strategic development decisions (large developments) [where it may then be called a strategic environmental assessment] or where a potential issue e.g. conservation status, has been identified within a planning proposal.

Other impact assessments relevant to development include social and economic impact assessments.

Any DSS for environmental planning needs to incorporate the information produced for an Environmental Impact Statement as a minimum input, see Table 3.1, and further, should incorporate the findings of any environmental impact assessment conducted at the local scale. Within the system, it should also be possible to represent any constraints which can be derived from the Environmental Impact Statement - for example, depict areas where development is prohibited.

3.3.3 Environmental perspectives in planning control and the regulatory framework

In order to assist the planner to make development decisions, the DETR has produced a series of Planning Policy Guidance Notes (PPGs). Table 3.2 lists those that have a particular relevance to environmental planning. They detail methodologies and actions consistent with government planning objectives, which should be incorporated in the local development plan. They also refer the planner to pertinent regulatory controls. Guidance is also provided by Minerals Planning Guidance notes (Table 3.3) and by other regulatory documents, including EU directives (Table 3.4).

In many cases, the local authority is the enforcing party to the above legislation and regulations. The planner therefore acts to ensure any requirements resulting from the legislation are met in the planning proposal. The planner or developer can seek further clarification from the Environment Agency (or SEPA in Scotland) on whether the proposed development will satisfy statutory requirements. In addition, many professional organisations provide guidance to their members on the application of statutory controls. For example, both the National House Builders Council and the Royal Institute of Chartered Surveyors have produced guidance on land contamination issues (NHBC, 1999; RICS, 1997).

As Planning Policy Guidance notes and Minerals Policy Guidance notes are used along with environmental information to reach a decision on a planning proposal, this guidance often constitutes a decision aid. Therefore a decision support system for planners needs to incorporate PPG and MPG frameworks, as well as relevant legislation.

Table 3.1 Contents of an EIS after Glasson et al. (1999

Content of EIS required by the T&CP regulations (1988) 1.

The following are the statutory provisions with respect to the content of environmental statements, as set out in Schedule 3 to the Town and Country Planning (Assessment of Environmental Effects) Regulations 1988.

1. An environmental statement comprises a document or series of documents providing for the purpose of assessing the likely impact upon the environment of the development proposed to be carried out, the information specified in paragraph 2 (referred to in this Schedule as "the specified information").
2. The specified information is:

   (a) a description of the development proposed, comprising information about the site and the design and size or scale of the development;

   (b) the data necessary to identify and assess the main effects which that development is likely to have on the environment;

   (c) a description of the likely significant effects, direct and indirect, on the environment of the development, explained by reference to its possible impact on: human beings, soil, fauna, flora, water, air, climate, the landscape, the interaction between any of the foregoing, material assets, and the cultural heritage;

   (d) where significant adverse effects are identified with respect to any of the foregoing, a description of the measures envisaged in order to avoid, reduce or remedy those effects; and a summary in non-technical language of the information specified above.

3. An environmental statement may include, by way of explanation or amplification of any specified information, further information on any of the following matters:

   (a) the physical characteristics of the proposed development, and the land-use requirementsduring the construction and operational phases;

   (b) the main characteristics of the production processes proposed, including the nature and quantity of the materials to be used;

   (c) the estimated type and quantity of expected residues and emissions (including pollutants of water, air or soil, noise, vibration, light, heat and radiation) resulting from the proposed development when in operation;

   (d) (in outline) the main alternatives (if any) studied by the applicant, appellant or authority and an indication of the main reasons for choosing the development proposed, taking into account the environmental effects;

   (e) the likely significant direct and indirect effects on the environment of the development proposed which may result from:

   - the use of natural resources;
   - the emission of pollutants, the creation of nuisances, and the elimination of waste;

   (f) the forecasting methods used to assess any effects on the environment about which information is given under sub paragraph (e); and

   (g) any difficulties, such as technical deficiencies or lack of know-how, encountered in compiling any specified information.

In paragraph (e), "effects" includes secondary, cumulative, short-, medium- and long-term, permanent, temporary, positive and negative effects.

4. Where further information is included in an environmental statement pursuant to paragraph 3, a non technical summary of that information shall also be provided.

Table 3.2 Environmental Planning Policy Guidance Notes (extracted from DETR, 2001)

Jan 1995	PPG 2	Greenbelts
Feb 1997	PPG 7	The Countryside
Oct 1994	PPG 9	Nature Conservation
Sept 1999	PPG10	Planning and waste management
Mar 1994	PPG 13	Transport
April 1990	PPG 14	Development on Unstable Land
Sept 1992	PPG 20	Coastal Planning
July 1994	PPG 23	Planning and Pollution Control
Sept 1994	PPG 24	Planning and Noise
April 2000	PPG 25	Flood Risk

Table 3.3 Relevant Mineral Policy Guidance Notes (extracted from DETR, 2001)

July 1998	MPG2	Applications, Permission and Conditions
March 1999	MPG3	Coal Mining and Colliery Waste Disposal
Aug 1997	MPG4	Review of Mineral Working Sites
Jan 2000	MPG5	Stability in Surface mineral working and tips
April 1994	MPG6	Guidelines for Aggregates Provision in England
Nov 1996	MPG7	The Reclamation of Mineral Workings
Jan 1991	MPG10	Provision of raw material for the Cement industry
April 93	MPG11	The Control of Noise at Surface Mineral Workings
March 94	MPG12	Treatment of disused Mine openings and the availability of information on Mined Ground.
July 95	MPG13	Guidelines for Peat Provision in England
Sept 96	MPG15	Provision of Silica Sand in England

(Note: The Welsh Assembly and Scottish Executive also provide guidance related to their planning framework)

Table 3.4 Key environmental legislation relevant to planning decisions

National Parks and Access to the Countryside Act	1949
Agricultural Land (Removal of Surface Soil) Act	1953
Wildlife and Countryside Act	1968
Agriculture (Environmentally Sensitive Areas) Act	1986
Environmental Protection Act	1990
Planning (Hazardous substances) Act	1990
Planning and Compensation Act	1991
Water Resources Acts	1991
Access to Neighbouring Land Act	1992
Conservation (Natural Habitats etc) Regulations	1994
Waste Management Regulations	1994
Environment Act	1995
The Contaminated Land Regulations	2000
The Building Regulations	2000

(Note: Copies of all Acts of Parliament and legislation are available from The Stationery Office, London (Tel: 0870 600 5522)

3.3.4 What other influences are there on Environmental Planning?

Central Government policies advocate a move toward sustainable development (DETR,1998b). The improvement and sensitive use of the environment is key to enhancing the quality of life for UK citizens. The local authority planner, through the development plan, has a duty to ensure that proper consideration is given to the protection and conservation of the environment (HMSO, 1990). In an urban context, the main issues are:

- The availability of green / recreational space to the community (within 0.5km of their home)
- The protection of SSSIs, RAMSAR sites and other designated ecological conservation areas e.g. National Parks
- The issue of development on flood plains / unstable land / contaminated land
- Locational factors in respect of Part IIA and IPPC process sites, both in terms of air pollution, and land contamination e.g. landfill
- Natural and anthropogenic environmental hazards
- Management of water resources and catchments
- Noise
- Pollution resulting from transport corridors and other infrastructure
- Use of environmental resources

However, planning applications do not all require the same level of environmental information. Issues of scale (regional versus local), size of development, adjacent land uses and the proposed future use of the site will dictate information requirements. For example, under the new Contaminated Land Regulations 2000, a site is first evaluated for 'suitability of use' for the proposed development. This may or may not require the proposer to provide an evaluation of the contamination risks presented by the site, either in its current state and/or after the proposed developed.

Similarly, a planner may use the results from air pollution plume modelling, to determine the appropriate land use adjacent to a facility subject to IPPC regulations.

Alternatively, the environmental aspects may not be of critical importance to the development. In order for the planner to reach a decision, it may be sufficient to recognise that there are environmental issues, but proposals may be driven by other social and economic pressures. Achieving a balance is the underlying ethos of sustainable development.

In practice, constraints such as economics and technology may prohibit the achievement of the optimum development option from an environmental consideration, and the planner may then only aspire to the best possible environmental option.

The Local Government Act (HMSO, 1999) requires the local authority to use its resources to achieve best value across its portfolio of services and responsibilities. One important consideration from the planning process is whether they have received 'best value' advice from external consultants. In some cases, this has prompted planning departments to embrace more specialist training for their own employees, so that the 'best value' is found in-house and is therefore cheaper than external sources. This approach has limitations when interpreting environmental information – particularly where such information has a formal scientific rather than social sciences base.

3.3.5 Current limits to implementing decision support systems in planning

Technology base

Many local authorities have now acquired GIS (RTPI, 2000), but the number of staff that have the necessary expertise and training in the use of the systems is limited. Much of the training has been in response to governmental initiatives which required the central supply of digital information i.e. the National Street Gazetteer (BSI, 2000) and the National Land Use database (NLUD). Other 'land use information' initiatives have had a similar effect in Wales and Scotland. There is still some way to go to provide a comprehensive national picture of ‘developed’ land use.

There is a perception that GIS requires a high skill level, particularly where usage demands more from the technology than simple data storage and retrieval. Take-up is further hampered by the lack of integrated systems at the local authority level, and the large amount of information that is still paper based (Alker et al., 2000). Information is available within the authority, but many departments do not know of its existence. This often leads to duplication of effort.

Many local authorities have failed to follow a comprehensive GIS strategy (RTPI, 2000), and there are many examples where systems have been bought on a departmental base, at discounted cost. This leads to incompatibility between departments and difficulty with information exchange. In the past few years, however, GIS providers have sought to address these compatibility issues.

Time

This applies in two areas:

The currency (age) of environmental and planning information - Although development plans provide a 10- year forward look, much development can take place in urban areas over this time span. Keeping information and models up to date is time-consuming, and can be complicated further by changes in legislation and regulation. Additionally, from an environmental perspective, many dynamic systems can change significantly over this time frame, particularly at the local level e.g. changes in flood plain dynamics due to construction of buildings.

Deadlines- Planning decisions are often made within strict time constraints that do not necessarily allow full consideration of outcomes.

Data reliability

There are 3 main issues here:

Resolution - Digital datasets need to be used at the scale for which they were intended. Data collected to provide national coverage may not support interrogation at site scale. For determining some planning applications, very detailed information may be a prerequisite e.g. species surveys or geochemical sampling of contaminated soils.

Interpretation - The ready availability of digital datasets means they may be unwittingly used for purposes for which they were never intended. Digital data often relies upon information that may be based on a relatively sparse number of data points. For example, the GBASE survey (sourced from BGS) provides metal and organic substance levels in soils based on a grid of 4 samples per km2. Interpolation of values between these sample points is conducted to give a digital isopleth map of substance levels in soil over the whole area. This interpolation is a mathematical process, and only gives an indication of the nature of the soil. The sparse data and modelling gives an assumed distribution, which in practice and on a local level may not be truly representative of the actual soil conditions.

Data coverage and data gaps - There are inconsistencies between data that are available nationally, and those datasets that exist at a local level, due to separate collection initiatives by national and local agencies. Site specific environmental information is often only produced at the request of the planning authority.

Decision complexity - The greater the number and scope of variables that are being dealt with in the decision-making process, the more likely that any decision support system will produce a number of alternative scenarios. Some of these may be impractical (due to constraints not considered in the design of the system), whilst others will appear reasonable. The latter could be produced artificially as a result of the multiplication of uncertainties within the DSS modelling process. For example, in an environmental DSS, economic considerations may not have been considered, but these will influence the final decision choice. Common sense is needed as a filter, but this is notoriously difficult to capture in a model. Human decision processing will be relied upon within the planning department for final adoption of any resulting outcome. Therefore any system must be transparent and the modelling mechanisms involved, understood by the planner so that unrealistic outcomes can be dismissed.

3.3.6 Needs

To be of practical use to a local authority, a Decision Support System for environmental planning should broadly aim to:

- be relatively quick and easy to use (with minimum skills level)
- be accessible
- be achievable
- be flexible (to allow adjustments for specific or local conditions)
- be user selectable(so that irrelevant information is not interrogated within the decision process)
- be transparent
- incorporate relevant regulatory, statutory and guidance procedures
- be able to interrogate and aggregate relevant information
- incorporate land use as well as environmental information
- allow the construction of ‘what if’ scenarios
- highlight ‘environmental’ constraints and regulatory concerns in any scenario
- provide an indicator of the degree of significance of environmental concerns identified for the development
- suggest the ‘optimum’ solution from the perspective of:
  -best value
  -best environmental option
  -sustainability

3.4. A review of decision support systems by environmental discipline

This section reviews examples of decision support used in environmental planning. Separate sections are devoted to each of the main topic areas, as follows:

Ground Stability (3.4.2)

Natural Contamination (3.4.3)

Contaminated Land and Landfill (3.4.4)

Surface water (3.4.5)

Ground water (3.4.6)

Land use planning and ecology (3.4.7)

Air quality (3.4.8)

Each section includes a brief introduction pertinent to that topic, followed by tables that summarise appropriate examples.

3.4.1 Overview

Independent studies (Klostermann, 1998; Harris,1998) have suggested that [computer based] tools for planning support are no more developed now than they were ten years ago. Most successful decision support systems are small, focus on a single issue, and address clearly defined objectives (e.g. insurance risk, flood risk). More complex systems designed to deal with a range of issues commonly fail to get beyond the development stage because the supporting environmental data and models are either not available or not relevant to the area under consideration. These deficiencies are being addressed through national initiatives (e.g NLUD, EA flood risk programme) but the procurement of high quality, national datasets requires long term investment and planning (the Environment Agency's flood risk programme has taken 5 years from inception to completion).

Many of the systems described in this chapter are not true decision support systems, and would be better termed decision aids; they only assist the decision process, although some incorporate management and expert systems elements (Latelin, 1997).

Paper-based systems

Paper-based systems based on flowcharts or check-lists are widely used by local authorities for processing planning applications These range from relatively simple consultation routines (Figure 3.1) to more complicated decision trees, in which development control procedures are fully documented (e.g.Thompson et al., 1989).

Examples of check lists:

Handbook on the hydrogeology and stability of excavated slopes in quarries. (HMSO, 1998)

Guidance for the safe development of housing on land affected by contamination. (Environment Agency, 2000)

Examples of flow diagrams / decision trees:

National House Builders Council Standards Ch 4.1. Land quality - Managing ground conditions (NHBC, 1999)

Procedures for the evaluation of potentially unstable ground. (G S L, 1991)

Computer-based systems

Many local authorities now possess GIS platforms (RTPI, 2000), which are used to store planning-related data, and for processing planning applications. Systems, such as that operated by Telford and Wrekin Council, are populated with a wide range of locally sourced data (e.g., local plan policy information, transport links, constraints maps), thus providing an efficient means of checking new applications for possible development conflicts. However, many local authorities have yet to integrate their systems across departments. For example, Leeds City Council uses differing GIS packages in its highways, environmental health and planning offices, and only recent has considered installing a networked system. Similarly, progress is relatively slow in populating these systems with locally acquired or existing paper-based data.

GIS technology is also widely used in commercial and research-based systems

Examples of digital, spatially-based GIS systems:

- Harrogate Borough Council: gypsum dissolution (Thompson et al., 1998)
- Environment Agency: flood plain mapping
- CEH Wallingford: flood risk mapping
- Homesight / Equifax: subsidence risk due to shrink/swell clays

- BGS: radon susceptibility

Examples of decision support systems:

Few systems were found that conform to our definition of a DSS. Those listed below deserve further investigation. It is perhaps significant that none is used in a local authority planning context:

- NERC/ESRC Land Use Programme (NELUP). River catchment management
- Urban Mines: Characterisation of brownfield sites
- West Midlands Urban biodiversity project
- Carver and Openshaw: Web-based interactive decision support tool for locating radioactive waste disposal sites

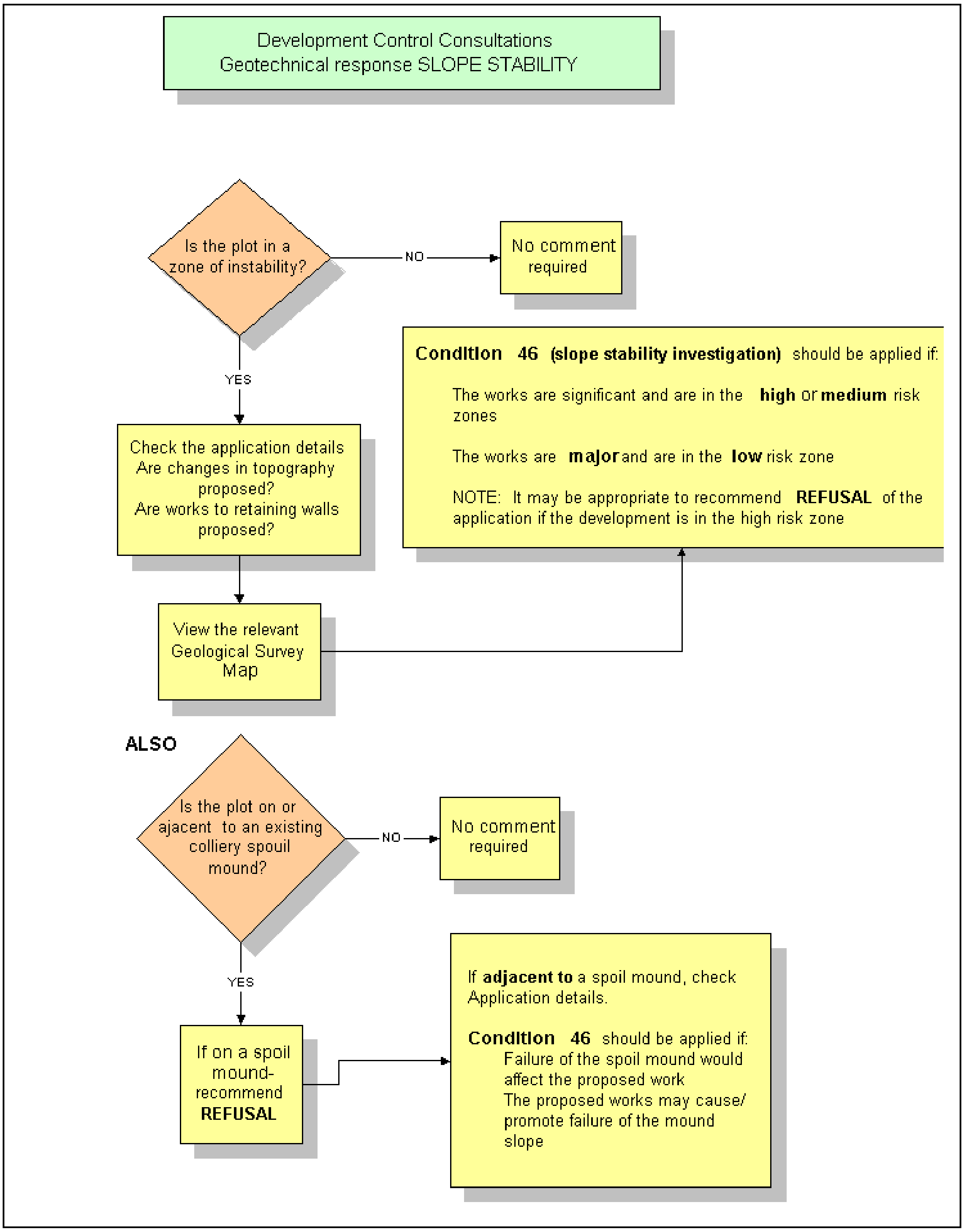

Figure 3.1 Slope stability consultation procedures (Telford and Wrekin Council)

3.4.2 Ground stability

In the UK, incidents involving ground instability pose a relatively small risk to life and health. Nevertheless, the damage caused to buildings and structures as a result of ground movement is substantial, and costs to the insurance industry are currently running at between £300- 500 million per annum (DETR, 2001). The main causes of instability are listed in Figure 3.2.

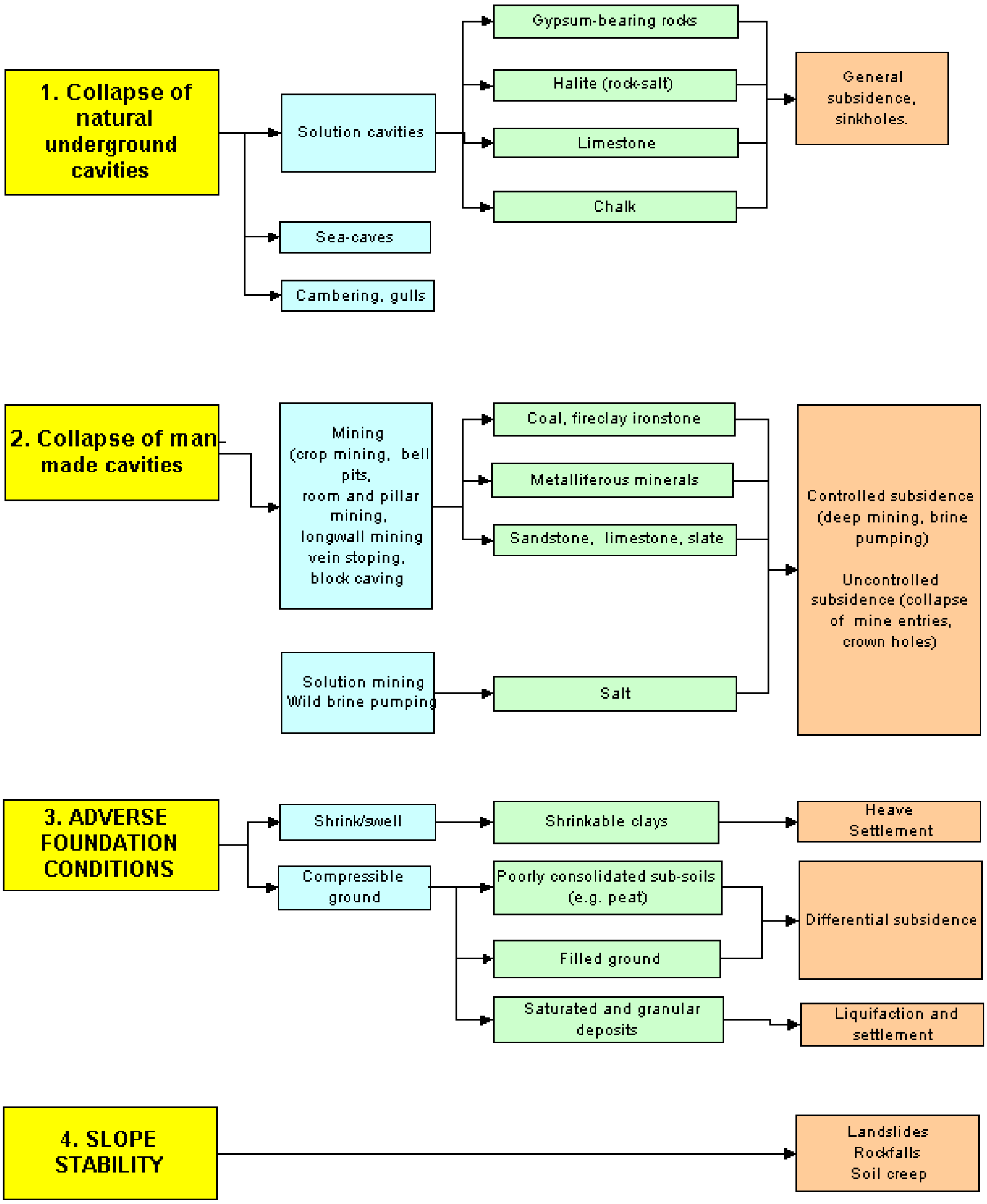

Figure 3.2 Causes of ground instability

Guidance on dealing with ground instability is set out in Planning Policy Guidance (PPG) Notes, Circulars, and technical reports, published by the DETR. PPG14: Development on Unstable Land (1990, 1996, 2001) is particularly relevant in this context. It emphasises local authority responsibilities and includes many recommendations on best practice, some of which have important implications on the ultimate design of the decision support system.

Other relevant research is contained in the national review surveys and case studies carried out under the DETR Minerals, Land Instability and Waste Planning Research Programme. These offer varying degrees of decision aid. They include:

- Review of foundation conditions in Great Britain
- Mining instability in Great Britain
- Review of instability due to natural underground cavities in Great Britain
- Treatment of abandoned limestone workings in West Midlands and Shropshire
- Assessment of mining subsidence in the South Wales Coalfiled
- Causes and mechanisms of land subsidence in Norwich
- Assessment of subsidence hazard due to gypsum dissolution - Ripon

Further details and references are given in Table 3.1.

Other important sources of information incorporating decision aids, are the 50 or so applied geological mapping studies commissioned by the DETR since the 1980s. Many of these were undertaken within coalfields to improve available information on areas which might be liable to mining subsidence. The most recent studies, such as those in the Bradford and Wigan conurbations, include constraints maps for a range of environmental hazards.

Passive and interactive systems

As noted earlier, flowcharts, checklists and thematic maps are commonly employed as procedural aids for dealing with ground-related problems. These are essentially passive systems/aids in that they depend on the user to follow a series of decision rules to arrive at an appropriate, almost pre-defined outcome. The schematic flowchart (Figure 3.3a), based on a landslide risk assessment study on Ventnor, Isle of Wight (Geomorphological Services Ltd, 1991), shows the principles. Shaded boxes represent stages in the decision making process where decision rules and support are required. This system relies on the knowledge and judgment of a competent person, to decide when there is sufficient information to make a decision. Most examples reviewed were of this type.

They offer several advantages:

- they are designed to target a specific issue
- they fit easily into the existing planning structure
- they can be managed without major investment in technology

Often however, they underuse or neglect available information.

In contrast, interactive systems, offer greater potential to test different scenarios. The only example found (No. 12, Table 4.1; Mejia-Navarrow and Garcia, 1996) was the result of a research project to examine landslide hazard in Colorado; it employs a second string of decision support that allows the user to test different scenarios based on variable inputs. The scheme is illustrated in Figure 3.3b. Although initially such a system may seem attractive and could simplify the planning process, whether it could translate to local authority use is uncertain. The level of skill needed by the operator, and the expertise in interpreting the different types of information are limiting factors. It should be noted that this system never progressed beyond the research stage.

Commercial systems

Environmental information is increasingly being made available to the public through the World Wide Web. Sites, such as those operated by Sitescope (http://www2.homecheck.co.uk/) and the Landmark Information Group (http://www2.homecheck.co.uk/), provide information on a range of environmental issues, including ground stability. These companies act as value added resellers, combining environmental information and datasets from a range of data providers to serve the needs of the property industry. The user interface is attractive providing a free listing of potential hazards, geographically referenced using postcodes. More detailed site assessments are available on payment of a fee.

A system, similar in concept but aimed at the insurance industry, is GHASP (Geo-hazard Susceptibility Package), developed by the British Geological Survey. This system maps out the susceptibility of the ground to each of six geohazards (shrink/swell clay, landslip, solution, mining, gulls, and compressible soils), and, based on hazard interactions, provides an overall hazard ranking.

All three commercial systems provide national, or near-national coverage. The supporting databases differ in their degree of resolution, but arguably few would satisfy the site-specific specific needs of development control planning.

Table 3.5 lists a summary of applications in Ground stability and Natural Contamination reviewed and table 3.6 gives examples of systems and decision aids for managing ground stability.

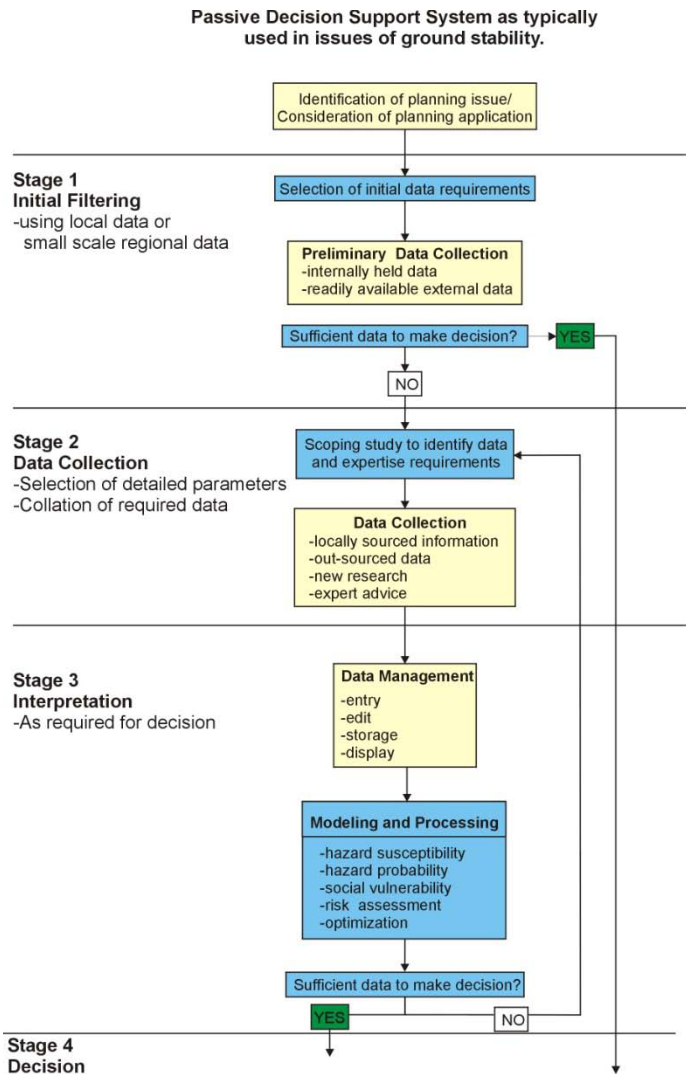

Figure 3.3. Passive and interactive systems for assessing landslide risk

a) Passive system (based on Ventnor study, Isle of Wight)

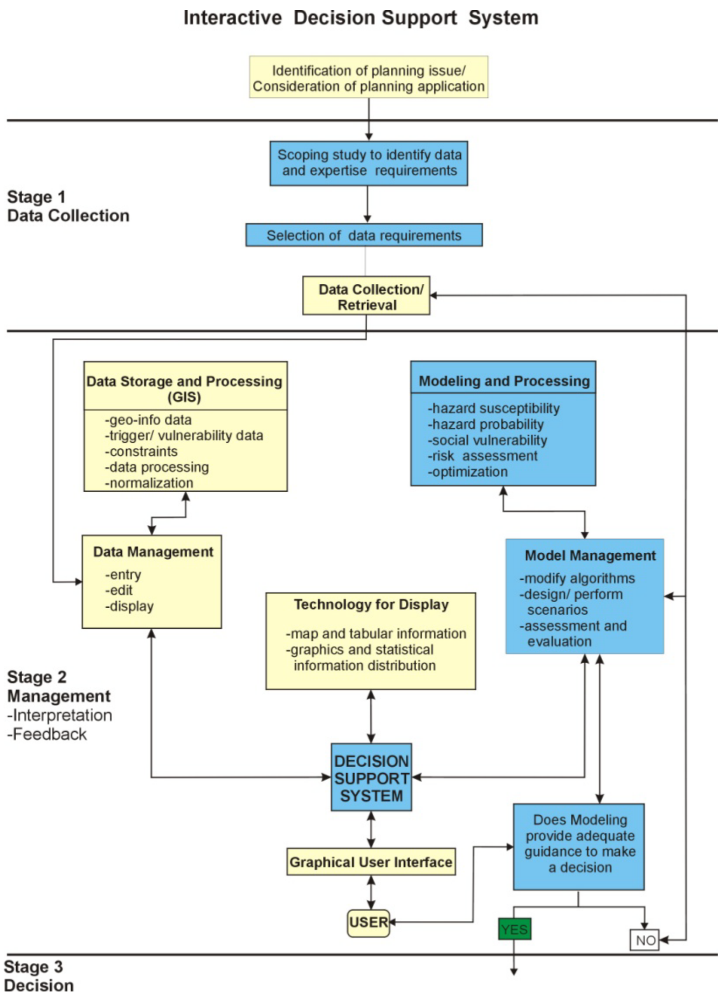

Figure 3.3. Passive and interactive systems for assessing landslide risk b) Interactive system (Colorado, Mejia-Navarrow and Garcia, 1996)

Table 3.5 Summary of applications in Ground stability and Natural Contamination reviewed

Primary End User	Local Authority											Regional/ National Authority									Other		
Case study Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Landslip	X	X	X	X								x	x								x		x
Shrink/swell	X																x	x					
Settlement	X	X		x	x	x	x	x	X							x	x	x			X	X	
Cavities	X	X				x	x	x	X		X					X							
Subsidence over mines	X				x	X								x	x						X	X	
Artificial slope failure	X																				X		
Radon																			x		X	x	
Carbon dioxide, Methane	X									X											x		
Potentially Harmful Elements										x											x		

Column headings (Tables 3.5, 3.6):

Primary End User. – The individual or organisation for whom the system was designed. Most systems have a wider applicability than intended at the time of their conception.

System – The method by which data are stored, manipulated and retrieved as part of the DSS. In the above examples, number 12 is the only truly interactive system, where the end user directly influences the decision support. In the majority of cases the user is a ‘passive’ element in the support system; although the user’s judgement and knowledge may often directly affect the decision made, they do not affect the decision rules.

Organisation – The organisation(s) mostly responsible for the authorship of the system.

Description – A brief description of the system and its intended primary role.

Input/output – The data and format of the information entered into the system and the nature of the output.

Abbreviations and Acronyms Used.

BGS - British Geological SurveyCA - Coal Authority

DETR - Department of the Environment, Transport and the Regions

DSS - Decision Support System

GI - Ground Investigation

LA - Local Authority

NRPB - National Radiological Protection Board

SI -Site Investigation

Table 3.6 Examples of systems and decision aids for managing ground stability

Primary End Use		System	Organisation	Description/ coverage	Inputs (source)	Output/ cost if known	Reference
Local Authority	1	Paper/ GIS	DETR	Thematic maps covering a range of constraints in selected UK conurbations. Produced as part of the DETR Applied Geological Mapping Programme. e.g Wigan	Geological Maps/ Reports 1:10 000 scale (BGS) Borehole Archive (BGS) Aerial photos 1:10 000 (LA) Mining archive (CA)1 Site investigation reports2	Summary planning constraints maps at 1:25 000 scale and accompanying advisory reports	e.g. Forster et al. (1995)
	2	Paper	DETR	Planning Policy Guidance Notes providing advice to local authorities Generic UK/National	-	Booklets providing guidance to Local Authorities on best practice. A list of information sources is included. Purchase cost £6-15	DETR (section 3.3 this report)

	3	GIS	DETR, Geomorpho-logical Services Ltd (G.S.L.)	Combined ground, geomorphological investigation and economic appraisal to provide a management scheme for landslides. Ventnor, Isle of Wight, UK	Geomorphological, landslide unit, land use and damage maps (contractor & LA) Movement monitoring (contractor & LA) Aerial Photos (contractor) All at 1:2 500 scale. Meteorological data as available Literature (LA, museums etc.)	GIS based on 1:2 500 scale data layers; used to prepare a paper planning guidance map which relates categories of ground behaviour to forward planning and development control	G.S.L. (1991) Appendix A
	4	Paper	Local Government	Hazard risk maps produced by local authorities to a standard format as required by national legislation. Switzerland	Geological, geotechnical, topographic, and environmental data, site history, scale and type as available.	22 zone land use planning maps at 1:50 000 scale 44 zone land use planning map at 1:50 000 scale	Latelin (1997) Appendix A
	5	Paper	DETR, Arup Geotechnics3	A series of Mining Reviews in the form of scientific reports and case studies covering the ground stability hazards associated with coal, metalliferous, rock and salt mining in .the UK.	Geological maps (BGS, BC) Abandonment plans, seam maps, mine boundary maps (BC) Subsidence records, ground investigations, maintenance contracts etc. (BC, LA) Scales vary but generally records are available at 1:50 000 with local reports often at 1:2 500 Literature (LA, museums etc.)	Summary maps* at 1:625 000 scale. Regional maps with technical reports and planning advice (3 zone thematic map) at 1:250 000.scale Regional reports cover target areas typically at 1:2 500 scale, they contain detailed information about mine workings and a 2 zone thematic map giving planning constraint advice.	For example Arup Geotechnics (1990), (1992) Payne (1986)

	6	Paper	Howard Humphreys and Partners	Determination of a methodology to enable planning response to ground instability in areas of mining and natural solution within Chalk. UK/ Norwich	Archive records as available	General guidelines for action by Local Authorities	Howard Humphreys and Partners (1995)

		System	Organisation	Description/ coverage	Inputs (source)	Output/ cost if known	Reference
Local Authority	7	Paper	Symonds Travers Morgan	Subsidence study to assess risk from gypsum dissolution UK/Ripon	Geomorphoogical, hydrogeological and hydrochemical studies	Development guidance maps with control areas defined and planning responses identified	Symonds Travers Morgan, (1996)
	8	Paper	Local Authorities	A series of thematic maps, which outline areas where a hazard may exist. The maps are used at the pre-planning stage to define the degree and scale of planning required of the developer.	Archive records as available including maps of geology, karst features, movement history and land use. Scales unknown.	Thematic Maps (scale unknown) indicating areas where ground hazards exist and defined planning ordinances must be actioned.	Dougherty (1989)
	9	Paper	Arup Geotechnics	UK/Staffs Halite dissolution: Stafford		1:10 000 scale maps	Arup Geotechnics, 1991
	0	Paper	EA/ NHBC	Document providing almost step-by-step instructions on how to carry out an investigation into potentially contaminated sites, including lists of pollutants, resources and contacts. UK/National	-	A booklet with several flow diagrams, primarily designed for planning applications but also intended for use by developers	Environment Agency (2000) Appendix 1
	1		Applied Geology Ltd,	Review covering the hazards of cavities produced by the dissolution of limestone and gypsum UK.		1: 625 000 scale maps; summary report 1:250 000 maps for planning regions	Applied Geology Ltd, (1993)

Regional/ National Authority	2	Int GIS	Colorado State University (INT)	Research and feasibility study into the use of DSS in assisting the management of landslide hazard Glenwood Spring, Col.	13 categories containing weighted fields input entered	DSS designed mainly to assess risk from debris flows	Mejia-Navarrow et al (1996) Appendix 1
	3	Paper	Central Government	Part of a project to assess ALL environmental hazards in France. (see separate report for details)	Questionnaire (LA) Geology, landslide, seismic, topographic, 'environmental' and demographic maps (LA, museums etc). All at around 1:50 000	A series of maps for use by local planners to indicate type, probability and intensity of hazard. Scales as per local plans of that area.	Flageollet (1989)
	4	Int DB	Illinois Geological Survey	Simple relational database designed around available archive data to produce thematic maps and statistics for land-use planning with respect to historic and planned coal extraction. Illinois	149 separate fields were input including details of geology, mining records, movement history and demographic data. Scales varied depending upon the data and coverage available.	Digital thematic map with 3 zones advising planning constraints. Also used to generate statistics to scope for and focus future research.	Treworgy (1991)
	5	Paper	DETR, Black Country Advisory Panel,	Report based upon research to establish the nature, extent and risk of collapse associated with former limestone workings and to produce methods of hazard mitigation. Black Country, UK	Archive records, plans, SI data	Maps and reports	DETR (1995)
	6		University of Newcastle	Review (currently underway) of existing subsidence management techniques within the European Union. The project will lead to the development of risk zonation and mapping criteria for evaporite karst terrain throughout the UK and continental Europe. EU funded 'Roses' Project run in the UK by Water Resource Systems Research Laboratory, (W.R.S.R.), University of Newcastle.			W.R.S.R. Laboratory. 2001

Table 3.6 (continued) Examples of systems and decision aids for managing ground stability

		System	Organisation	Description/ coverage	Inputs (source)	Output/ cost if known	Reference
Regional/ National Authority	7	Paper	Wimpey Environmental & NHBC.	Review to provide advice to planners and developers on the extent and nature of difficult ground throughout the UK.	Archive ground investigation reports.	1: 625 000 scale maps; summary report 1:250 000 maps for planning regions	Wimpey Environmental (????)
	8	Paper	Regulator/ developer	A simple classification which, using basic soil characteristics, can determine broadly the expansive characteristics of soils.	Several different criteria are given which cater for a range of different soil tests typically carried out during site investigations.	Different building codes are suggested for each set of behavioural criteria.	Bell & Maud (1995) Appendix 1
	9	Paper/ Digital map	BGS/NRPB	The product of a research programme which aimed to provide planners relevant data in a form useful to them in the planning process. UK/National	Radon potential based upon solid and drift geology maps at 1:625 000 (BGS) Radon house surveys covering high risk areas at 1:50 000 (NRPB)	Map showing % of houses likely to have high levels of radon in a 5*5 km square, based on OSGB Grid	Appleton (2000) Appendix 1
	0	?	BGS	UK/National Hydrocarbons UK			
Other – intended for multiple end- users or private individuals	1	GIS	Sitescope-Commercial	Commercial product offering postcode-based geohazard information: UK/National	Range of regulatory and proprietary databases under licence: including for example: EA, BGS, NRPB	Basic online assessment (free). Un-interpreted written reports. Range of services to industry and local government.	Homecheck (2000) Appendix 1
	2	GIS/ paper	Landmark-Commercial	Post code-based geohazard information: similar to Sitescope UK/National			Landmark (2000) Appendix 1

	3	I nt GIS	Local and Regional Planning Agencies	A series of thematic maps to be easily incorporated into the local planning process and to be of use to multiple professional users. Hong Kong coverage	Aerial photographs. (LA) Maps of geology hydrology, vegetation, landforms, erosion, terrain all at around 1: 20 000. Geotechnical archive & new ground Investigations. (LA, museums etc)	Maps available for all of the raw data collected as well as maps of varying levels of interpretation: engineering geology, engineering data, physical constraints, and a four zone planning constraint map. Each map at scales 1:20 000 and 1:2 500	Brand (1988) Appendix 1

Table 3.6 (continued) Examples of systems and decision aids for managing ground stability

1 The Coal Authority (formerly British Coal) holds a range of databases in both digital and paper form. These include 1:625 000 and 1:50 000 boundary maps of working an disused coal mines, abandonment plans, mineshaft registers, geological maps and mine plans. Coverage and quality varies from area to area and some information remains confidential.

2Typically available from National Agencies, County, District and Borough Councils, private contractors and the BGS. These range from small, site specific accounts to large ground investigation reports and monitoring programmes.

3Formerly Over Arup and Partners, under which moniker a number of regional reports were written, for example Ove Arup & Partners (1985).

3.4.3 Natural contamination

A range of substances, classed as natural contaminants seep from the ground naturally or are released as a result of human activity. These substances include heavy metals, radon, methane, carbon dioxide, and hydrocarbons. Radon released from rocks and soils disperses quickly in the open air but it may accumulate in poorly ventilated buildings and mines where it is a potential health hazard. In order to limit the risk to individuals, the Government has adopted an Action Level for radon in homes of 200 becquerels per cubic metre (Bq m^{-3}). BR 211 (1999) provides revised guidance on protective measures for new dwellings, and defines the geographical areas where radon protection is necessary. It is supported by a GIS-mounted relational database, which links measurements of household levels of radon (provided by the National Radiological Protection Board) with surface geology.

Methane and carbon dioxide emissions are associated mainly with coal and peat deposits. Methane is only freely released from coal either in the vicinity of geological disturbances, such as faults, or as a result of degassing of adsorbed gases as the coal is fractured during mining. The risk of gas emission at surface may increase if groundwater rises. Much of the carbon dioxide derived from coal mines is formed by the oxidation of coal through biological processes. Methane is potentially explosive whereas carbon dioxide is toxic in high concentrations. Both gases may act as asphyxiants and cause vegetation die back. The hazards associated with the build-up of methane and carbon dioxide are discussed fully by Appleton et al. (1995). Susceptibility maps, and an accompanying report, show the areas in the UK that are most risk.

Contamination of the natural environment is associated, in most cases, with human activity. The BGS through its Geochemical Baseline Survey is providing a database on the occurrence and distribution of a wide range of Potentially Harmful Elements (PHEs) in both urban and rural settings. BGS has also produced a PHE map with accompanying report, showing areas in the British Isles with above background concentrations of five selected elements (lead, copper, zinc, arsenic and cadmium) (Appleton, 1995).

3.4.4 Contaminated land and landfill

Planning guidance for contaminated land and landfill is presented in PPG 10, Planning and Waste Management (DETR, 1999) and PPG 23 Planning and Pollution control (DETR, 1994), the later being currently under review. These provide planners with guidance on planning decisions with regard to the Waste Management Regulations 1994 that are also detailed in Waste Management Paper No 26b (DETR, 1995) (currently under review) resulting from the Environment Act 1995 and Environmental Protection Act 1990. PPG 23, Planning and Pollution Control, is currently being revised to include the Contaminated Land Regulations 2000. From a planning perspective the broad issues that these documents cover are reviewed from a development perspective and include:

- licensing of waste disposal facilities
- handling and transportation of wastes
- restoration, monitoring and control of current and disused landfill sites
- land contamination
- pollution

Contaminated land and landfill issues have become increasingly important in urban areas as pressure to redevelop disused land increases. This is partly due to the perceived risk of contamination of previously used sites, by landowners, developers and the public, and over the past few years and increased media interest due to a number of well-publicised incidents. The Contaminated Land Regulations (DETR, 2000) adopt a risk management approach, in terms of assessing the source, pathway and receptor for any contaminants that may be present on previously used land. This risk assessment can involve investigation of site-specific environmental information, such as levels of particular contaminants, as well as wider environmental information and issues such as underlying drift and solid geology, groundwater regimes etc. Whilst the planner may not actually perform this risk assessment, they may be presented with the results of such an exercise in order to make a planning permission decision. Evaluation of this very specific information when provided within the planning proposal is therefore a specialised task.

Table 3.7 summarises the findings of an investigation into the use of decision support systems in planning that consider contaminated land and waste management issues. Many deal simply with prioritisation or risk assessment procedures and are therefore not necessarily directly integrated into the planning decision framework, despite the fact that the models for risk assessment often use a PC platform. They should therefore be considered as planning decision support tools as they provide information, but do not actually provide a planning decision. Similarly there are many examples of PC-based systems incorporating a GIS that are used as an information base only within a local planning authority. For example, Portsmouth City Council and Swansea County Council both have GIS systems which are used with historical map information and environmental data to depict former contaminative land uses.

Specific landfill-based decision support systems are almost non-existent, most landfill being considered as a type of land contamination and therefore being assessed using the risk management based decision tools for contaminated land. However, two of the landfill examples Open Spatial decision making on the Internet (Carver, 1997) and Promethee (Hokkanen, 1997) provide examples of decision systems used in a clear strategic planning context, despite being research based. These should be investigated further for the purpose of this research. There were a number of GIS based systems used for the siting of waste disposal facilities (mostly transfer stations), for example Crichton (1992) but, on closer inspection, these were revealed to be systems based on logistical or economic data, and contained no environmental information, so have not been described here.

Table 3.7 Contaminated Land and Landfill DSS

Country	Name	Organisation	Description	Inputs	Models	Outputs / Costs	Planning application relevance	Reference
UK	Risk Management Strategies	WDA	Risk management framework to produce procedures for strategic decision making	Historical data, geological, hydrogeological, geochemical, ecosystem data. Local plan	Check lists and spatial info	Paper based risk assessment	Strategic	(Smith, 1998) Appendix B
UK	NHBC Standards Chapter 4.1 Land quality – managing ground conditions	National House Builders Council	Flow chart to advise builders with regard to the assessment of potentially contaminated sites	Desk study, walkover survey, site investigation reports.	Check lists and flow chart	Paper based Hard copy	Identifying contamination hazard	(NHBC, 1999) Appendix B
UK	SNIFFER	Scotland and Northern Ireland forum for Environmental Research	Risk assessment framework for deriving site specific numeric targets for contaminant concentrations in soil.	Figures for: Contaminants of concern, Tolerable daily intakes, Mean daily intakes, site use and exposure pathways	Mathematical, within a checklist framework	Written report of expert opinion	Specifically relating risk from any contaminant to end use of land	(SNIFFER, 2000) Appendix B

UK	Classification of brownfield sites	Urban Mines	Potential decision support system to assess the sustainable development of brownfield redevelopment decisions	Economic, Social and Environmental data. Historical, Geological, Topographical, groundwater and local plan data	Multi Criteria Analysis	Identification of site critical characteristics based on aggregation of environmental information. Spatially represented Digital output	Related to local plan information	(Alker et al, 2000) Appendix B
WORLD WIDE	RBCA – Risk Based Corrective Action	USEPA	Tiered approach to decide remedial action for leaking underground petroleum storage tanks	Geological information, exposure conditions, future land use,	Risk assessment and probabilistic modelling	Corrective measures and optimum solutions	Site and scenario specific. Highly specialised.	(USEPA, 1998) Appendix B

Country	Name	Organisation	Description	Inputs	Models	Outputs / Costs	Planning application relevance	Reference
UK	CONSIM	Environment Agency	Risk Assessment tool to evaluate the impact of contaminated land on groundwater	Ground conditions, geological information and groundwater information. Pollutant levels at source.	Conceptual modelling, probabilistic and Monte Carlo analysis	Numeric values	Determination of risk from contaminants	Appendix B
UK	CLR6	DoE	Prioritisation and categorisation procedure for sites that may be contaminanted	Site investigation information. Local plan. Ground and surface water information	Paper based flow chart procedures	Prioritises to 4 categories, that then indicate action needed.	Prioritises sites for further investigation, information requirements and/or remedial action	(DoE, 1995) Appendix B
UK	Open Spatial Decision making on the Internet	University of Leeds	Interactive spatial decision support system for the land use planning and siting of radioactive waste disposal facilities in the UK	Demographic, Geological, Conservation, and Spatial information	Multi Criteria Evaluation	Spatial prioritisation of siting locations	Strategic	(Carver et al, 1997) Appendix B.
UK	LANDSIM	Environment Agency	Risk assessment modelling of likelihood of pollution event due to egress of landfill leachate	Waste characteristics Meteorological information	Conceptual modelling, probabilistic and Monte Carlo	Numeric values to give a risk assessment	Landfill specific	Appendix B

				Geology Groundwater Landfill-liner properties	analysis			
FINLAND	PROMETHEE	Paavo Ristola Ltd / University of Jyvaskyla	Model for siting of a waste facility, incorporating full EIA and stakeholder participation	Effects on: Groundwater Surface water Landscape Ecology Noise	Multi criteria decision modelling	Ranks each alternative siting	Strategic planning spanning 9 authorities	(Hokkanen 1997) Appendix B
UK	GROUND VIEW	AEA TECHNOLOGY	System for organising, analysing and presenting information related to contaminated land	Site investigation reports, maps, photos and monitoring records	None	Standardised report of spatial information	Really a data storage facility. Used by Oxford and Newcastle city councils	(Holford and Swannell, 2000)

Table 3.7 Contaminated Land and Landfill DSS (continued)

3.4.5 Surface water

In April 2000, the Department of the Environment, Transport and the Regions (DETR) published for consultation new guidance for flood risk areas in England (PPG25). The Government proposes that local authorities include floodplain surveys in local plans and recognises that greater emphasis needs to be placed on the potential impact of future climate in the planning process.

Flood risk has particular importance for urban areas where substantial damage can be caused by flooding, in addition to loss of essential services, such as communications and transport links.

An internet search and review of decision support systems with respect to flood and flood extent, with emphasis on the planning stage, has revealed that Decision Support Systems (DSSs) come in two main forms, although there are variations:

Non-interactive – particularly as maps which show areal extent of flooding for a specified return period (e.g. 100 years). These are generally available to the public, either on the internet or as hard paper copies. Many of these types of system can be, or have already been, incorporated into the second form, interactive systems, outlined below.

Interactive - interactive software packages which enable the user to simulate the effects of constructing flood defences or changing land use. The systems are usually GIS-based, with the associated heavy data requirements, and can also be highly sophisticated, using remotely-sensed flood extent information, Digital Elevation Models, etc.

Table 3.8. Summarises the general features of the systems reviewed. Other systems, not included in the table, offer more operational capabilities, such as real-time forecasting of floods, but this has less applicability at the planning stage e.g. ISIS, MIKE 11, RFFS.

To date, insurance companies have been the driving force behind the development of DSSs. Many of them are in-house systems primarily for evaluating flood risk in terms of economic loss, taking into consideration density and value of housing. However, the way the systems operate, and the subsequent dissemination of the resulting information, are not always public-domain information.

In the UK, the Environment Agency's indicative floodplain map for England and Wales gives a outline of the areal extent of the 100-year flood (or 200-year for coastal flooding. Newly released, and available on the Internet (via http://www.environment-agency.gov.uk/), it provides an instantaneous method of viewing the flood risk for any given area. The Agency is also able to provide guidance on specific development projects

In the USA, one of the Federal Emergency Management Agency (FEMA at http:\\www.fema.gov\fema\) responsibilities is to reduce the effects of future floods by advising on building codes and flood plain management. One of FEMA's initiatives in this area is a Flood Hazard Mapping Program which has enabled production of Flood Insurance Rate Maps (FIRM) for communities most at risk. Covering over 1200 counties, the flood maps include Special Flood Hazard Areas (SHFA's) which show the extent of the 100-year flood.

Currently under development by the European Research Consortium for Informatics and Mathematics is a system called Data Fusion for Flood Analysis and Decision Support (ANFAS). Applicable to specific catchments, ANFAS is being designed as both a planning tool and as an aid to limit flood damage and/or perform emergency evacuations by enabling the user the run simulations, such as the effects of reinforcing dykes or intentionally breaking dykes. See http://www.ercim.org/anfas/ for more information.

Table 3.8 Surface water DSS

Country	System/ Organisation	Description	Extent	Return Period	Inputs/Models	Outputs www	GIS	Paper	Planning angle - application	Example areas
Non-interactive										
UK	EA Floodplain map	Map of England and Wales showing extent of flooding based on 100-year return period	Y	100	Flood levels, flood extents and terrain data	Y	N	N	Identifying areas at risk. Requests user to enter postcode	England and Wales
UK	IH Floodplain map	Flood risk map for England and Wales	Y	100	Flood levels of different probabilities derived from historic time-series projected on digital elevation data.	Y	N	Y	Identifying areas at risk	England and Wales
USA	Virtual Times	Real-time map of USA - maps of precipitation, flood risk								USA
USA	Federal Emergency Management Agency (FEMA) - National Flood Insurance Program	Produces Flood Insurance Rate Maps (FIRM), based 100-year flood for most at-risk communities	Y	100, 500		N	N	Y	Identifying areas at risk by user supplying address, zip code	At-risk communities in USA
USA	FEMA	Digital Q3 Flood Data 100 and 500 year floods over 1200 counties	Y	100		Y	Y	N	'You can overlay the Q3 Flood data to display zones for potential risk and identify future marketing opportunities'	At risk communities in USA
Canada	Flood risk map	Large Scale Engineering Maps and Public Information Maps displays extents of floods for varying return periods	Y	200		N	N	Y	Identifying areas at risk	Canada
Global	Dartmouth Flood Observatory	Uses satellite remote sensing of large river floods	Y	actual	Satellite remote sensing of real flood events	Y	Y	N	Identifying areas at risk	Selected rivers

Table 3.8 Surface water DSS (continued)

Country	System/Organisation	Description	Extent	Return Period	Inputs/Models	Outputs www	 GIS	 Paper	Planning angle - application	Example areas
Interactive										
Europe/ China	ANFAS Data Fusion for Flood Analysis and Decision Support	To develop a simulation and prevention tool for decision makers. To be employed for planning and emergency scenarios. (under development)	Y	-	Remotely sensed data, geological, hydrological data, land use data where available	N	Y	N	Limit damage by predicting the effects of structures such a dams, dykes. Will enable the user to run simulations and model the effects of human constructions	Vah river, Slovakia Loire river, France JingJiang Reach, China
Greece/Italy	NOA -TELEFEUR	Telematics assisted handling of flood emergencies in Urban Areas	-	-	Meteorological, hydrological data and models	N	N	N	More of a real-time response system to handle emergencies, like EA flood warning system	Athens, Genoa
USA	Tactician	Maps featuring FEMA Flood Plain Boundaries	Y	100	FEMA flood plain data	N	Y	N	Identifying areas at risk	Selected communities
USA	Flood Impact Decision Support System for St Charles, Missouri	Derived from Flood Insurance Rate maps	Y	100, 500	Geological, hydrological data, land use data where available	N	Y	N	Developed to compare alternative floodplain management schemes in St Charles, Missouri	St Charles, Missouri
USA	Integrated Planning Decision Support System (IPDSS)	Incorporates a range of geographical data with FEMA flood maps and historic data. Assesses risk as a function of hazard and vulnerability	Y	-	Geological, hydrological data, land use data where available	N	Y	N	Ecosystem sensitivity, economic vulnerability, social infrastructure vulnerability. Intended use for Governments and Communities	Non-specified
USA	Flood Risk Analysis	Applies FEMA Q3 data with knowledge of housing value, density to determine level of risk assessment	Y	100	Uses FEMA Q3 data	N	Y	N	Employed for insurance risk assessment	USA
Honduras	Flood Risk Mapping / USGS	Uses 50-year flood, elevation data	Y	50	Geological, hydrological data, land use data where available	N	Y	N	For use by the Government to aid rebuilding of the country's infrastructure and housing.	Honduras
Other										
New	Wellington Regional	Developed a 'flood hazard assessment' for each river/stream to help determine a floodplain management plan								

Zealand	Council						
Europe	EUROTAS - Floodrisk mitigation	Development of a Framework for an integrated catchment modelling system includes a decision support system					
USA	Flood Plain Management Services - Corps of Engineers	Provides general technical services and general planning guidance.				Information by enquiry	

3.4.6 Groundwater

Groundwater protection and management is regulated in England and Wales by the Environment Agency (EA), and in Scotland by the Scottish Environment and Protection Agency (SEPA). The Environment Agency's Policy and Practice for the Protection of Groundwater (1998) sets out the legislative framework, and outlines the local authorities areas of responsibility. The policy document recognises six main threats to groundwater:

- Physical disturbance of aquifers and groundwater flow
- Waste disposal
- Contaminated land
- Disposal of liquid effluents and slurries
- Underground discharges
- Diffuse pollution of groundwater

Maps showing groundwater vulnerability and groundwater protection zones highlight those areas most sensitive to contamination and are intended to encourage better judgments to be made on land-use allocation.

The EA has also recently made available to all local authorities digital copies of many of its core databases, including:

- Integrated Pollution Control Sites (Environmental Protection Act 1990 (Part A)
- Licensed Abstractions from ground and surface water
- Sample points for discharges into a watercourse

- Pollution Incidents

The models and databases currently used by the EA for groundwater management will form part of a separate appraisal later in the year. Table 3.9 lists a few of the many environmental research projects that cover this theme.

Table 3.9 Links to DSS that include groundwater as a topic

Title	Location	URL
Decision Making for a Clean Urban Environment	n/a	http://www.mcs.surrey.ac.uk/Personal/csx1lm/Kbdss/EngDConference.html
Development of a Decision Support System for Catchment Management	Zululand	http://www.ccwr.ac.za/knprrp/bkel(web).htm
ECOSIM - Ecological and environmental monitoring and simulation system for management decision support in urban areas	n/a	http://www.rec.org/rec/programs/telematics/enwap/gallery/ecosim.html
ECOSIM Telematics Applications Project	n/a	http://www.ess.co.at/ECOSIM/Deliverables/D1001.html
Geospatial Decision Support Systems	Nebraska	http://spatial-info.unl.edu/description.html
Spatial Decision Support System for Rural Land Use Planning	Kolar District, Karnataka	http://pages.hotbot.com/edu/geoinformatics/f44.html
The Development of a 4-Dimensional GIS/CADD-Based Decision Support System for Managing Environmental Remediation Projects	n/a	http://www.watermodelling.org/html/4d_gis_cadd.html
Vulnerability Assessment in Central Canterbury	Canterbury, New Zealand	http://soilphysics.okstate.edu/vulnerability/NZ/index.html
Water Resources Institure: Decision Support System	Michigan	http://www4.gvsu.edu/wri/dss/introduction.html
WATERSHEDSS	n/a	http://h2osparc.wq.ncsu.edu/about.html

3.4.7 Land use planning and ecology

There is an extensive literature on the potential uses of DSS for environmental and land use planning. There is considerable less on their actual practical use. The resources required just to maintain the information should not be underestimated (Swetnam 2000). More recent DSS seem to be much more focused on single small issues rather than trying for holistic comprehensive systems.

Table 3.10 Indicates the basic themes (fully integrated approaches, planning/zoning, environmental impact assessment and sustainability) plus an estimate of the user community. Table 3.11 gives a description of these systems.

Table 3.10 Overview of issues for ecological and land use DSS

	User Community				
Theme	Local Authority	National / Regional Government	Conservation / Environmental NGOs	Public	Commercial / Business
Fully Integrated approaches					
1.	X	X	X		
2.	X	X	?	?	?
3.	X			?	
4.	X	?	X	X	X
Planning / Zoning					
5	X	X	X	X	X
6	X	X	X	X	X
7	X	X	?	X	X
8	X	X	?	X	X
9	X	X			
10		X	?		
11	X				
12	X				
13	X				
14	X				
15	X				
16	X				
17	X				
18	X				
19	X				
20	X				
EIA					
21	X				?
22	X				?
23	X				?
Sustainability and Agenda 21					

24	X				
25	X				
26	X				
27	X				
28	X				
29	X				
Ecological Infrastructure					
30	X				
31	X				
32	X				
Landscape Assessment					
33	X				
34	X				
35	X				
Waste Disposal					
36	X				

Table 3.11 Description of DSS found in Ecology and Land Use Planning

System ID	Type	Description	Inputs	Outputs (&costs)	References
1.	Unix, Interactive correlative models (ecological Economic and hydrological)Interactive process based models (ecological, economic, hydrological,) "Off-line"	The NERC/ESRC Land Use Programme (NELUP) DSS is capable of assessing the impact and interactions of a wide range of scenarios (climate change, land use change, agricultural and economic changes) on the economics, ecology and hydrology of a river catchment.	Land use, Land cover, Land capability, Soils, Geology, Topography, Hydrological network,	Maps, Time series, Graphs. (the shell is easily available but most of the input data is outlandishly expensive and covered by copyright restrictions)	Wadsworth 1995, O'Callaghan 1995, McClean et al 1995 Haslam & Newson 1995

	process based models (hydrology), relational databases, GIS, GUI		Meteorology, Species distribution (invertebrates, plants, plant communities, birds), Agricultural statistics (parish statistics), Agricultural statistics (farm level economics), Water quality, Water flow, Water management,		
2	PC. Relational database, GIS, models	The integration of ecological, hydrological, economical and social components of a badly disturbed region of Eastern Germany	Similar to above but with additional social statistics and information on groundwater resources	unknown	Bellmann (2000)
3		Integrate economic, environmental and social choice criteria in land-use planning			Mallawaarachchi et al (2000)
4		"… multisector goal programming model to study the interrelations among biophysical, social, and economic factors in three major resource sectors: agriculture, forestry, and wetland" (Canada)			Yin (1995)
5		Belgium system to reallocate land holdings have to take into account many factors to ensure economic fairness and to provide environmental benefits.			van Huglenbroek & Martens 1990
6		Dutch system to reallocate land holdings have to take into account many factors to ensure economic fairness and to provide environmental benefits.			van Lier 1988
7		Czech system to reallocate land holdings have to take into account many factors to ensure economic			Sonnenberg 2000

		fairness.			
8		Portuguese system to reallocate land holdings have to take into account many factors to ensure economic fairness.			Van Huylenbroeck et al 1996

Table 3.11 (continued) Description of DSS found in Ecology and Land Use Planning

System ID	Type	Description	Inputs	Outputs (&costs)	References
9		Particular reference to land allocation in relation to transport routes.			Brzuchowska (2000)
10.		of land use planning at a European scale,			Buurman & Wagtendonk (2000)
11.		Portugese system (ORBI) for land use zoning, includes impact on fauna and flora.			Gray & Stokoe (1988)
12.		Australian system for land use zoning (ADAPT)			Gray & Stokoe (1988)
13		USA system for land use zoning (ETIS), used by US Corp of Engineers since the 1970s.			Gray & Stokoe (1988)
14.		Italian system to examine landscape and agricultural constraints around cities.			Danuso et al (1999) Spaziante (1999)
15.		System to examine landscape and agricultural constraints around French and Italian cities.			Polidori et al (1999)
16		Zoning development in Valencia, Spain "LUPIS facilitates the generation of alternative land-use plans by adjusting the relative importance attributed by multiple stakeholders to preference and avoidance guidelines. The system leads to the allocation of competing land uses to mapping units in accordance with their preferred resource requirements, conditional upon the resource base of the area and the stakeholders'			Recatala et al (2000)

		demands.".			
17		Site selection in the USA			Cowen (1995).
18		Land allocation for forests in Australia			Cocks & Ive 1996
19		Land allocation for forests in Australia, trade-off between production and environment			Faith et al 1996
20	PC. Air quality and water quality models	Pollution control and urban planning in Vienna and Geneva	Land use, Land cover, Topography, Human population density, Industrial and non-point sources of pollution, Meteorology (hourly wind speed, direction, temperature, position of boundary layer).		Fedra & Reitsma 1990, Fedra 1990, Fedra 1999, Fedra & Haurie 1999 Fedra et al 1996

Table 3.11 (continued) Description of DSS found in Ecology and Land Use Planning

System ID	Type	Description	Inputs	Outputs (&costs)	References
21		Deciding in an EIA is required (plus advice on what to include) (Germany)			Schwable 1988
22		Deciding in an EIA is required (plus advice on what to include) (Italy)			Colorni & Landiado 1990, Colorni et al 1999
23		Deciding in an EIA is required (plus advice on what to include) (general European conditions)			Schibuola & Byer 1991, Luhar & Khanna 1988
24		Sustainable development in the USA			Wyman & Wyman 1999
25		Sustainable tourist development in Cuba			Gutierrez 1999
26		Sustainable rural development in Denmark			Hansen 2000
27		Agenda 21 in Denmark			Fjortoft 2000
28		Sustainable development and carrying capacity in India			George et al 1997 Khanna et al 1999
29		Rural sustainability and land use planning NW Europe segregation vs, integration; framework			van Lier 1998

		planning; ecological networks or infrastructure.			
30		Importance of wildlife corridors (greenways)			Ahern 1995
31		DSS for urban forests in Finland			Niemela 1999
32		Community forests			Wollenberg et al (2000
33		Landscape structure and assessment (primarily visual and scenic qualities)			Cudlip et al 1999
34		Landscape assessment especially of trees, Canberra Australia			Brack et al 1999
35		Landscape change (visual and scenic qualities)			Palang 2000
36		Waste disposal			Caruso et al 1993, Berger et al 1999

3.4.8 Air Quality

Air quality in urban areas of the UK is widely monitored by council agencies and by the DETR. A large dataset is available on the DETR web site for the major urban pollutants including SO_2, NO, NO_2, O_3, PM_{10}, $PM_{2.5}$ and a range of the most important volatile organic compounds including benzene and 1,3 -butadiene. In any planning process, the exposure of the public to urban air pollutants is considered important, for example, when:

- the development will significantly change traffic flow and therefore population exposure to potentially damaging air pollutants;
- the urban pattern of pollutant emission is considered in a traffic management scheme;
- new buildings will significantly change the ventilation of street canyons and thus the exposure of the local population to air pollutants;
- specific emissions generated by new development represent a potential threat to human health or to urban ecology.

Nitrogen oxides and ozone

The background, regional air pollution climate of the country is provided by national UK data sets held by the DETR, NETCEN and NERC-CEH. These include national maps of photochemical oxidants, notably ozone. In urban areas the local ozone concentration is depleted by reaction with NO to form NO_2. Thus the exposure of urban population to ozone is generally smaller than in rural areas. However, the dominant gaseous pollutants in the UK, NO and NO_2, generally referred to as NOx, are a major component of gaseous urban pollution. The concentrations generally range from 10ppbV (NOx) to 100ppb as hourly average concentrations, but are very sensitive to the meteorology and to local source strength. Current emission source strengths are available at a resolution of 1km x 1km from NETCEN and form the basis of estimates of the severity of air pollution in web-based post code indices.

Sulphur dioxide

The other major gaseous pollutant in urban areas is SO_2, which used to be the major urban pollutant and, along with smoke was responsible for substantial excess mortality in the London smogs of the early 1950s, especially in London. The introduction of smoke control areas has largely eliminated SO_2 as a major hazard for human health in the majority of UK towns and cities. There remain areas with elevated SO_2 concentrations and these can be identified in the UK SO_2 maps available in the DETR air quality web site.

Aerosols

The removal of SO_2 and smoke, did not entirely remove the threat to human health from particles in the air (more widely known as aerosols). The presence of aerosols, mainly in the small size classes of 0.1 to 10 um dia, are associated with increased morbidity and increased mortality and are the primary concern among air pollutants for human health effects.

The concentration fields of each of these pollutants can, in principle be estimated throughout the UK. The national maps available from the DETR, NETCEN and CEH data bases may be used to provide a rough guide to the range of exposure. More precise estimates of local concentrations may be achieved using:

- Local modelling based on a detailed local source inventory and application of a plume model.
- Application of urban enhancement parameters on the regional field from UK wide statistics.
- A combination of local measurements and plume modelling studies
- Application of CFD (computational fluid dynamics) modelling techniques (these are especially valuable in the case of street canyon exposure).

Heavy metals and other less common pollutants

The pollutants considered above are widely distributed, and are a common feature of all urban areas of the UK. However, the specialized economies of many of the industrial cities of the UK leads to features of the pollution climate which are peculiar to certain areas and cities. These pollutants are not widely monitored, and except in the case of particular notable cases are not well quantified. For the planning processs to be able to detect these special cases, it would be necessary for data bases of the industrial activity and emission characteristics of the areas in question to be developed. In the absence of these very specialised data, the current UK inventories for heavy metals may be used with a transport, diffusion and deposition model to quantify the probable exposure to the main metals Pb, Cu, Zn Cd and Hg. However, the uncertainty in these concentration maps are very large.

3.5 Summary

3.5.1 An overview from a planning perspective

Planners require environmental information in order to satisfy the regulatory and statutory framework within which they exercise planning control. However, one of the principles of sustainable development, is that decisions should be based on the best possible scientific information and analysis of risk. This places an increasing responsibility on local authorities to consider the wider implications of decisions that relate to environmental issues. Many systems have been developed to assist in environmental monitoring, as evidenced by the many decision support systems presented in Chapter 4; however, few actually serve the specific needs of the planning sector.

Environmental information is used in both spatial planning decisions (e.g. the granting of individual development planning permissions and the location of facilities) and in non-spatial planning at the strategic level. It can be used to develop resource management strategies (e.g. minerals and waste plans), and also for siting of regionally or nationally important facilities (e.g. airports and defence establishments).

Planning Policy and Minerals Planning guidance is used by the planning authority to ensure that the environmental information that they hold, meets any objectives as set out within the development plan, and conforms to statutory requirements. The nature of this guidance often constitutes a decision aid. Therefore a decision support system for planners needs to incorporate these frameworks.

The system also needs to be flexible enough to accommodate policy, guidance and legislative variations between the devolved countries comprising the UK, and changes in existing or new legislation.

This study has shown that there are no fully integrated, computer-based decision support systems, operating to assist the planner at the local authority level. It is more usual to find paper-based decision support aids, such as checklists and flow charts, being used in conjunction with spatial information stored within a Geographical Information System.

Research has demonstrated that decision support systems can be useful at the strategic planning level (Carver, 1991) however, there is little evidence that DSS are actually used in the UK for this purpose.

Future use of a DSS from a planning perspective could help to ensure:

- Consistency – all information that is available in order to arrive at a decision is evaluated systematically [and is not subject to variation in value judgements] and each planning decision would be evaluated using the same mechanisms and procedures.
- Transparency – the procedures within the DSS would need to be clearly defined and traceable. Therefore any decisions made would have an identifiable reference for the decision outcome.
- Economy – once an integrated system that incorporated sufficient datasets and structures is established, the processing of planning decisions should benefit in cost terms, by not having to acquire new information for each planning decision. This would assist in the achievement of best value practices within the planning authority.

3.5.2 Current use of decision support systems in planning

Examples of decision support systems that were found to be using environmental information for planning purposes, and which should be investigated further are listed in Table 3.12.

Table 3.12 Key decision support systems that use environmental information in a planning context

Name	Type of system / DSS	Main information included	Reference
NELP – NERC / ESRC National Land Use Programme	Interactive, correlative and process models, with relational	Most Environmental information	Wadsworth (1995)

	databases.		
DS Tool for locating Radioactive Waste Disposal	Interactive PC based DSS using MCE	Demographic, Geological, Spatial and Conservation	Carver (1997)
PROMETHEE (Finland) Location of landfill facility	Integrated DSS using MCE	Groundwater, Surface Water, Landscape, Ecology and Noise	Hokkanen (1997)
Landslide Management – Ventnor, Isle of Wight UK.	Paper guidance maps produced using GIS and flow charts	Geomorphological, Meteorological data and stability monitoring data	G.S.L. (1991)
Landslide Hazard Management, Glenwood Spring, Colorado. Colorado State University	Integrated DSS using MCE weighting	Multiple Categories	Mejia-Navarrow et al (1996)
ANFAS Data Fusion for Flood Analysis and Decision Support (under development)	Integrated GIS based DSS. Flood event simulation and prevention tool	Remotely sensed data Land use, geological and hydrogeological data	

These examples all demonstrate:

- elements of good practice
- conform to the regulatory / statutory framework, and
- and identify clear pathways for the decision process

However the data resources are often:

- costly to procure, and
- sometimes client confidential, either for legal, financial or copyright reasons.

Other points brought out by the review process are worth re-stating:

- Most examples are limited in their geographical extent
- Most applications are designed to deal with very specific environmental applications
- At some point in the decision process, expert interpretation is needed in order for the procedure to continue
- Only a few incorporate the ability to include stakeholders other than planners in the decision process, i.e. most are designed to meet a specific end user requirement.
- Most are based on a flowchart or a decision tree structure, that gives limited ability to vary the decision to account for local or unusual circumstances
- Several approaches have been used to deal with the same issue. For example, five systems deal with the risk assessment of contaminated land (section 4.4). Although there are similarities in approach, and they all deal with same information base, it is difficult to determine which methodology is superior with respect to the decision outcome.
- Many have been developed on a research basis, and it is unclear whether these initiatives and products have moved fully into a real world application.
- Many documented decision support aids are based on economic criteria. Environmental information is only incidental. For example, most cost benefit analysis models (that are used to make decisions) do not specifically include environmental datasets, but only incorporate an indicator of actual or net environmental benefit, or the ‘environmental improvement’ as a consequence of the decision analysis. Hardisty et al. (1998) consider alternative remediation techniques for contaminated sites in terms of time and cost. The environmental information is used simply to define the impact of the decision choices, and is not an integral part of the model.

3.5.3 Nature and scope of an integrated environmental planning decision support system

This review (Alker et al., 2001) has shown that current use of environmental information and decision support systems in planning is based on the following formats and methodologies:

- Paper or PC base

- Map or report output, that requires further interpretation and decision making
- GIS primarily used for information storage and retrieval
- Checklist, flow diagram or decision tree methodologies that are structured
- Passive or interactive approaches

There are a few research-based examples that attempt to introduce greater flexibility and influences into the decision process, for example by using weighting mechanisms against data within modelling techniques (multi-criteria analysis and evaluation). Some of these allow the user to consider alternative scenarios and different stakeholder perceptions by manipulating the data and varying the outputs. The effectiveness of these systems is not evaluated here.

It is clear that within the UK planning system, the complexity is such, that environmental issues will only be fully addressed at all stages of the planning process, if the information is made more accessible and presented in a format that can be readily integrated with other issues.

Figure 3.4 summarises the critical elements of an environmental decision support system. Further work is needed to establish a set of end-user requirements in terms of needs, delivery, and functionality of the system resulting from this research.

The general requirements of a system to serve environmental needs have already been listed.

Preliminary discussions with planning authorities suggest that in order to achieve best value, the end user requires, in addition, a system which:

- aggregates and selects relevant parts of guidance, regulations and procedures
- aggregates and selects relevant representations of information
- tests ‘development’ scenarios
- finds ‘optimum’ solutions from a number of stakeholder perspectives
- includes a measure of the reliability of the information
- provides achievable and sensible solutions
- is flexible enough to adapt to local conditions

It should not be overlooked that many of the environmental systems under consideration within a planning context are dynamic. Procurement of new data is a costly undertaking, and therefore any system needs to be adaptable to allow the easy incorporation of new information. This includes elements that have not been considered fully here (e.g. water catchment management, noise). Some of these are already subject to commercial undertaking, for example NoiseMap 2000, which can mean that there may be licensing issues to consider if this information is to be included within the system.

The regulatory framework can change as illustrated by recent and forthcoming EU directives on water catchment and radon. Therefore any decision support system needs to be flexible enough to allow the user to introduce or access these and other changes without the need for a completely revised version of the system.

Therefore, in designing a decision support system for planning purposes, the following additional issues need to be considered:

- whether a web based interface would allow greater user participation, and facilitate data integration
- issues of public access
- issues of data ownership and commercial confidentiality
- appropriate methods to indicate to the end user the relative importance of the issues under evaluation (perhaps by a rating system)
- how new information / controls be accommodated?

On the basis of the information presented above, it is possible to define the broad elements of a decision support system for environmental planning (Figure 3.4).

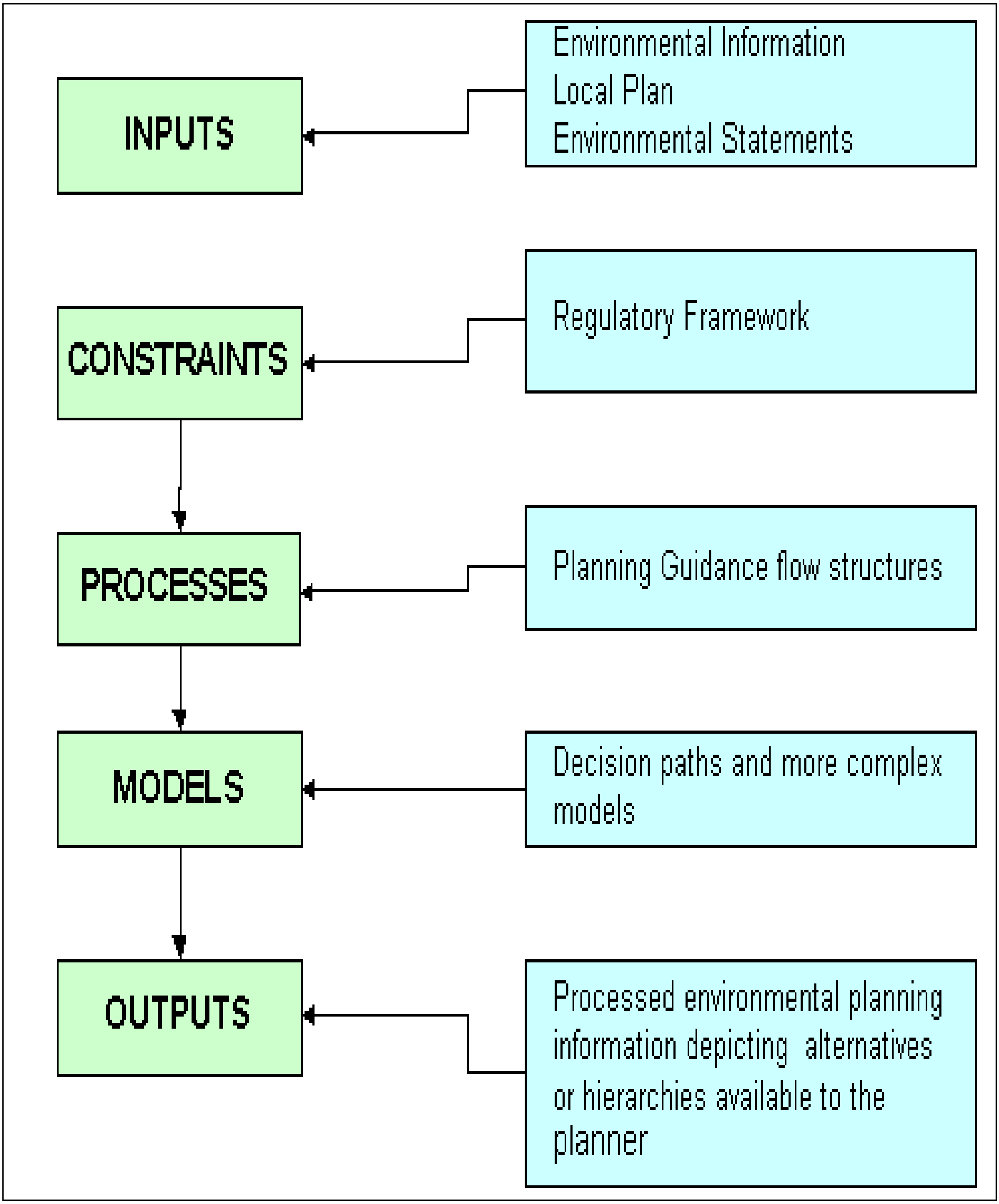

Figure 3.4 Elements of a decision support system for environmental planning

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Chapter 4 A Functional Specification for an Environmental Information System for Planners

4.1 A review of other related activities involving planning

Since the research started and the review in chapter 3 was completed, a number of initiatives with relevance to this project have been examined for links, common ground and overlaps with regards a possible functional specification for an Environmental Information Planning Tool. These include recent 'e-government' initiatives, planning related activities and systems using environmental information to inform specific activities within planning or the public domain. Many of these have provided insights into the functional requirements of an EISP, and the key initiatives are described briefly here.

4.1.1 Planning Inspectorate - The Planning Portal Programme

The Planning Inspectorate, whose main role is dealing with planning appeals in England and Wales, is leading a programme of work to develop e-business systems in support of the Modernising Government agenda and associated targets. The programme consists of two main projects, the Planning Portal and the Casework Service. The Planning Portal (target date 2005) will be a general planning advisory service linking the public, business and other users of the planning system to a wide range of advice, guidance and services on planning related topics. The service will be accessed via a single managed Internet portal, that will link all relevant organisations and will itself be linked to UK Online. The Casework service project is more advanced. It is essentially an electronic planning casework document handling and tracking facility. Principally for the use of Planning Inspectors when acting as consultees to planning appeals, it is being piloted in Wales at present. Based on an early (1998) casework tracking system, it is a bespoke system developed in Uniface running under the VMS computer operating system, with a Relational database at the back end. More details are available at www.planningportalprogramme.gov.uk.

In 2002 the programme received more funding (current total £6.2million), and is now proceeding with project procurement with the major part of the project being awarded to an IBM consortium including the ESRI web based GIS. IBM Websphere content management software will be used alongside a GIS interface to link maps with text.

The Planning Portal was launched in April 2002 for its 20+ Local Authority partners (including Swansea council – the one overlap with this project's contact working authorities) with a public launch by the end of 2002. XML (eXtensible Markup Language) data transfer standards for use in planning and GIS data exchange being developed by the planning portal project under the auspices of the UK government's eGIF programme (www.govtalk.gov.uk) were due to be published in Spring 2002 – and the EISP will aim to use those standards as appropriate.

Initially the portal will host an introductory guide to planning and planning guidance (for England and Wales; Northern Ireland and Scottish executives are being kept informed) and advice on the ideal way for local authorities to display development plans on-line. Eventually it is intended to expand to aid the production of Local Plans and the submitting and handling of planning applications.

It seems possible that the EISP could be linked into this portal around the target date of 2005 as a tool, but there is no current overlap in functionality at present between the portal and EISP. A complementary initiative www.infoshop.org.uk originating from the Cabinet office is a one-stop shop which allows local government front-line staff to use a decision tree web pages to answer complex queries from the public and includes an example of planning regulation enquiries.

4.1.2 Farming and Rural Conservation Agency – MAGIC

MAGIC (or Multi-Agency Geographic Information for the Countryside) is the first web-based interactive map in the UK to bring together information on key environmental schemes and designations in one place. It is being developed using funds from the 'Invest to Save' Budget (a centralised government budget created to help government departments work together in innovative and more efficient ways) and from both the Department for Environment, Food and Rural Affairs (DEFRA) and the Department for Transport, Local Government and the Regions (DTLR). Each participating organisation will benefit by having access to information from the other partners in the project and summary data will be made available to the public using the Countryside Information System.

The project will be led by the DEFRA's Geographic Information Unit and will involve English Nature, English Heritage, the Countryside Agency and the Forestry Commission, as well as DEFRA and DTLR. All of these organisations are involved in the development and implementation of rural policies in England. This involves the collection and use of data on a wide range of land management schemes and countryside and environment designations. Sharing this information is intended to lead to improved decision making and increased efficiency. MAGIC will result in a shared geographical information resource of rural and countryside information that will be accessed using a web-based GIS. The URGENT EISP project team have seen a demonstration of the trial facility. More details are available at www.magic.gov.uk. The MAGIC project has stated that when providing web based geographic information, the system needs to be designed to:

- Be simple, pragmatic and use existing standards for data (where they exist)
- Be easy to both maintain and use

The MAGIC report ‘Context Review’, examines a number of other land based electronic information initiatives, such as the National Land Use Database (NLUD) and the National Land Information Service (NLIS). These act principally as information sources, but are not directly related to the planning decision making process or environmental information. However, these projects are relevant for terms of reference in the consideration of ‘data standards’ input into the EISP system.

The MAGIC system is a basic web based GIS data layer viewing system using non-urban oriented datasets and therefore does not overlap with EISP scope but can be considered adjacent to it.

4.1.3 Environment Agency – Better Town Planning, DPS2 and GEMS

As a major consultee to the planning process, both in decisions at development control level and in strategic planning, the Environment Agency deals with 110,000 planning-related enquiries per annum. The Better Town Planning initiative, sees the Environment Agency developing e-commerce facilities and links with planning authorities, to deal with planning enquires in a semi-automated fashion via electronic communications. Most work to date has been internal to the EA but it is hoped that future developments may mean that queries from Local Authorities are passed to the consultee via e-mail.

Each area office has a dedicated team of planning officers who review these enquiries and forward them to specialist consultees within the agency for appropriate advice. Over the past two years, the EA has been integrating activities between the area offices, and developing automated systems, currently known as Development Planning Service Version 2 (DSP2). DSP2 is currently being implemented in all area offices and is expected to be fully functional by the end October 2001. The functionality of DSP2 includes:

- Electronic service delivery via the Internet
- The automatic interrogation of a suite of GIS data layers, against a checklist of questions in order to flag and allocate the application to the specialist consultee for more detailed consideration. A paper record (checklist of decisions/ layers interrogated) is generated at this stage, and is the only paper report generated. A database also records 'application history' and as this is linked via a reference polygon, will eventually flag prior planning related enquiries for any particular site.
- An ability to input site parameters from the planning application, with location by either polygon, point, postcode or grid reference facilities
- The ability to vary and buffer constraints for the GIS data layers dependant on environmental aspects of the application
- The ability to automatically generate response letters at both planning officer and specialist consultee level with standard objection or condition phrases applied, and the facility to add additional text (Word based)
- Password protected access

- A Decision System designed in Visual Basic and Oracle, using MapObjects Lite for basic GIS layer map presentation on the user client Desktop PC (licence free)

The GEMS (Generic Environmental Management System) project builds on the DPS2, by adding the following functionality:

- a gazetteer to locate properties if no post-code is supplied
- the ability to print out full reports and edit maps
- the ability to use national data-sets rather than 'area based' information
- the incorporation of local plans

As a tool being used in-house in the Environment Agency (EA) the GEMS system is valuable in helping to define the scope of EISP. The GEMS system went live at the end of 2001 and includes the EA flood risk maps, which will also be part of the EISP.

4.1.4 IDEA – Go with the Flow

The IDEA (Local Government Improvement and Development) Go with the Flow project was completed two years ago by the Independent Development Agency (formerly Local Government Management Board). It is also linked to a LEAP 'Life Events Applications' project – using 'e' initiatives to provide a citizen focus for publicly held information. The project produced 96 flow charts, prioritising functions which shared core data, such as address and land and property information, which would benefit most from information sharing and integration. Four areas were mapped in detail - land and buildings, planning and economic development, highways and transportation and environmental services, that indicate the information and people connections and work flow within local authority departments and functions. This initiative is linked with the provision of an Electronic Service Delivery (ESD) toolkit – this itemises service delivery in 706 local authority functions, allowing targeting for effective integration of 'e' services to achieve 2005 targets most effectively. More information is available on www.idea-infoage.gov.uk . Although

the reports are paper based, they clearly demonstrate the systems already in place within local government for handling planning decisions.
In terms of functionality for our system, the relevant Go with the Flow charts will provide one means of checking the context of our significantly more detailed environmental decision flows.

4.2 System functionality features that are recorded from the local authorities

As part of the questionnaire and interviews described in chapter 2, the participating local authorities responded to proposed system functionality features of an EISP and the resulting choices are presented in Table 4.1 ranked as popularity scores. These proposed system features were the result of Rapid Application Development (RAD) iterative consideration of standard system components and the interview feedback from the local authorities following the Dynamic System Design Methodology (DSDM Consortium, 1999). Local authorities were encouraged to propose features they considered would be useful in response to the features the team proposed. The additional comments column contains mappings to government initiatives that would be enhanced by the implementation of an EISP.

Table 4.1 Functionality of system: Features that would be of use to local authorities

Scores: 2 = strongly requested, 1= requested blank = desire not expressed

Ranking is rank order of feature according to total score

A= Telford and Wrekin

B= Wolverhampton

C= Glasgow

D= Swansea

E= London Borough of Newham

Features of system	A	B	C	D	E	Total score	Rank	Additional Comments
Logging into the system (including dates) for input of planning application details and pre-planning enquiries. This includes input of variables pertinent to the decision flows. System should also enable access at later points within the planning decision process.	**2**	**2**	**2**	**2**	**2**	**10**	**1**	**Already performed**
Allows pre-planning enquiries to be responded to, in real time. This requires simple entry to the system via a polygon, point, post-code or grid reference point, and automatic interrogation of primary constraints for each module of environmental consideration, in order to report that an issue may be present.	**2**	**2**	**2**	**2**	**2**	**10**	**1**	**Best value**
Clearly identifies / flags issues and constraints, providing the planning officer with sufficient detail as to the nature of environmental considerations which may be an issue for the development.	**2**	**2**	**2**	**2**	**2**	**10**	**1**	**Awareness raising**
Tracking progress (including delegation / transfer) record – the system needs to record the stage of progress through the decision flows, particularly when the planning decision awaits response from external sources in order to proceed with the decision process.	**1**		**2**	**2**	**2**	**7**	**4**	**To monitor performance**
The system needs to accommodate the requirements to inform the strategic planning process. This includes recording planning decisions and providing the best available environmental information relevant to the strategic planning process.		**1**	**2**	**2**	**2**	**7**	**4**	**Added value**
Tools to inform the planner regarding risk or sensitivity of a particular environmental consideration. This is integral to some flows that provide information to support risk assessment, however, sensitivity is a subjective analysis and the degree of sensitivity must be evaluated by the planning officer from the best environmental information possible / provided within the system.	**2**	**1**	**1**	**1**		**5**	**4**	**Best value**
Generated reports at stages within the decision process. The key stages for a prototype system are at the pre-planning stage – via a checklist of primary constraints for each environmental consideration, and at the overall planning decision on application stage- to list the environmental considerations that have been interrogated, and the outcome of this interrogation.	**2**		**2**			**4**	**7**	**e-gov**
Local authority decisions are subject to public access, therefore the decision process must both be transparent and traceable. Traceability also provides input to internal local authority quality assurance measures.	**1**	**1**		**2**		**4**	**7**	**Awareness raising and Best value**

Features of system	A	B	C	D	E	Total score	Rank	Additional Comments
Available via e-communications – most authorities have access to the internet and are moving toward internal communications between departments via e-mail. It would be sensible to allow the modules for environmental considerations to interrogate best environmental information held internally and externally to the local authority by electronic means. Queries and responses to consultees arising from the decision flows should also be passed by electronic communications.	**2**			**2**		**4**	**7**	**e-gov**
Summary sheet listing environmental considerations and specific constraints examined. A paper output will be provided at the pre-planning stage. Planning application decisions will be supported by a database report within the full decision support system.		**2**		**2**		**4**	**7**	**Added value**
The ability to add data / revise / update layers [a dynamic database], by the local authorities themselves. This is not appropriate for a prototype system.			**2**	**2**		**4**	**7**	**Added value**
Prompts for the user to request further information are built into the environmental consideration decision flow modules via flags to consultees, expertise or information.			**2**	**2**		**4**	**7**	**Best value**
Modelling of environmental trends and influences i.e. cause and effect modelling. Whilst this is clearly an important function for local authorities to address, they are not currently in a position to model this effectively. Environmental information and science from the project members may provide some input to this functionality, but full 'what if' modelling may only be demonstrated for very specific environmental considerations within the prototype system i.e. air quality.			**2**	**2**		**4**	**7**	
Quick access – the planning officer should be able to enter the system via a simple reference code, post code, polygon, street name, point on map or grid reference related to the planning application. The system should give the option to the planner to start from the beginning again, or proceed to where the application had last progressed to - for example, in terms of the decision point that control was transferred to a consultee.				**2**	**2**	**4**	**7**	**Best value**
Inform review of Environmental Statements and consultants reports. The system will enable the planner to distinguish those environmental considerations that should be assessed within any environmental reports submitted within the planning application.			**1**	**1**	**2**	**4**	**7**	**Added value**
The system must contain security measures such as password protected access to ensure the data and system is only used by those authorised to access it.			**2**	**2**		**4**	**7**	
A proportion of the decisions within the environmental consideration decision flow modules will be determined automatically. This is important for speedy response to pre- planning enquiries.	**1**	**2**				**3**	**16**	**Added value**
Accessible to wider audience than just planning officers. Many authorities are moving toward more open government strategies, and would like developers and other stakeholders to have access to a similar system, providing a potential to reducing conflict in the planning decision process and thereby speed up decision making. Issues of data access mean that this is not appropriate in a prototype system.	**1**		**1**	**1**		**3**	**16**	**Awareness raising**

Features of system	A	B	C	D	E	Total score	Rank	Additional Comments
The production of decision flow modules for each environmental consideration can also provide hard-copy documented procedures for the local authorities.		**2**		**1**		**3**	**16**	**Added value**
The system hopes to provide the best environmental information available against each required decision. Therefore more appropriate information will be used within the planning process.		**2**		**1**		**3**	**16**	**Added value**
The production of decision flow modules for each environmental consideration is based on planning guidance, local plan policies etc. Data-sets used to make decisions is therefore complementary to relevant policies.			**1**	**2**		**3**	**16**	**Legislation**
An integrated environmental decision support system provides a basis for the co-ordination of environmental data and information.		**1**	**2**			**3**	**16**	**Added value**
Provides relevant environmental information to support those applications which would go to Committee – provided in a summary report and database.		**2**				**2**	**22**	**Added value**
The system should incorporate land uses, both available from base OS maps (landline) but also as allocated within the local plan.			**2**			**2**	**22**	
The system needs to be compliant with other electronic information initiatives, data standards and protocols e.g. NSPF / BS7666, so that it can incorporate information from other sources.				**2**		**2**	**22**	**e-government**
Categorises criticality of issue – many authorities would like to know how 'severe' an issue is with respect to the planning proposal. However, this is often subjective and the final decision rests with the planning officer. Therefore the system will not gauge the severity of an environmental consideration, merely present the issue to be considered by the planning officer.				**2**		**2**	**22**	**e.g Nature capital and capacity studies**
A record of data accessed will be held in the reporting database.	**1**					**1**	**29**	
Within the system consideration should be given to reporting the data accuracy, relevance and uncertainty of data used to support the decision modules. This may take the form of an electronic or paper meta-data report.	**1**					**1**	**29**	
The system should incorporate flags to consultees and other external bodies for input to the decision making process at appropriate points.	**1**					**1**	**29**	**Links to e-government**
Tools for visualisation – the local authority planner should be able to see both the decision flow procedures and the data supporting each decision if needed. Decision data may need to be provided in hard-copy to support the planning decision.	**1**					**1**	**29**	
A web interface would enable both internet access of data held in external locations (to the local authority) and also a relatively straightforward user interface.			**1**			**1**	**29**	**e-government**

It was also noted that the system should not merely provide tools that improve the way present planning procedures are carried out but also include informed comment on how the planning process could be improved to take account of common overlapping environmental issue interactions, some of which are illustrated in Figure 4.1.

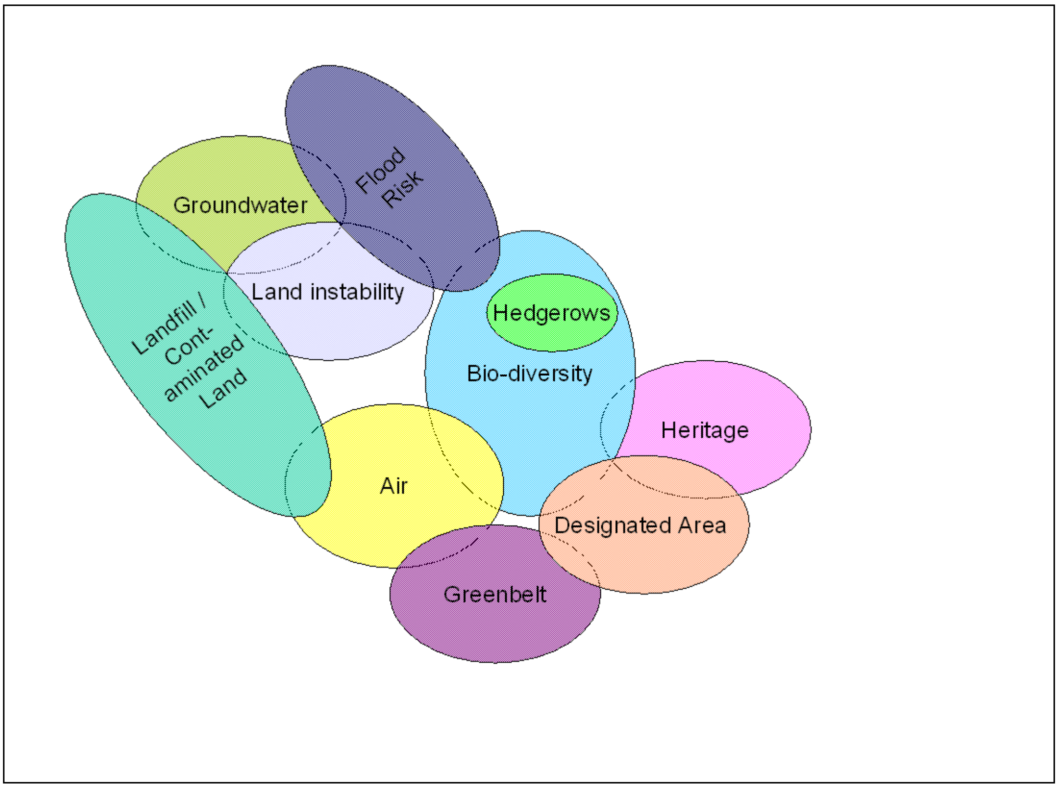


Figure 4.1. An illustration of environmental considerations and various overlaps between environmental topics, for inclusion within an Environmental Information System for Planners

4.3 Requirements collation

The identified collated system functionality requirements: from the interviews with the local authorities, the literature and existing system reviews, the analysis of the planning framework, the availability of identified relevant environmental datasets and the expertise being brought to bear by the NERC URGENT programme, were for a decision support system to assist with the environmental aspects of:

- Pre-application enquiries

- Planning applications
- Strategic planning

And this incorporates the objectives:

- To provide a Decision Support Tool to the Local Authority planning application process
- To provide a Decision Support Tool to the Local Authority Development Plan process
- To assist Best Value and the Environmental performance of UK Local Authorities

In addition:

- The system should be designed primarily for local authority personnel, principally planners.
- The design should assume that the user organisations have reasonable computing facilities and access to GIS datasets and the internet.
- Table 4.1 informs us as to the priority functionality perceived as required by the identified user of the prototype system.
- The proof of concept version of the system should be internet based.

Three processes needed to be facilitated by the decision support system, the Environmental Information System for Planning (EISP):

1. Pre-planning applications
2. Planning applications
3. Strategic planning

The first two should be designed to help the user with planning application decisions. The third should be designed to help ascertain where development of a particular size and type might be allocated.

The planning process is covered by a set of rules defined in a variety of statutory documents and guidelines and is in a constant state of dynamic change.

As required by section 54A of the T&CP Act 1990 and related legislation, a planning application must be determined in accordance with the development plan unless material considerations indicate otherwise. A major element of such considerations are environmental factors as specified in government guidelines. The applicant must supply information about the application which is then examined against the environmental considerations specified in these guidelines. These documents include legislation, planning guidance and local plans. Some of the environmental considerations are straightforward and it is a simple matter to determine if the application should be recommended. Other environmental considerations are more complex and may require the interrogation of maps and other data sets to determine the acceptability of the proposal. Yet more complex environmental considerations may require modelling and/or specialists or official bodies to be consulted. In some cases, the result will be that the application is acceptable provided that the applicant complies with certain conditions.

The principal environmental considerations to be initially determined are listed below in Table 4.2, together with the question (primary constraint) that qualifies the environmental consideration.

Table 4.2: Primary Constraints, as derived from Draft Environmental Consideration modules (Project team perspective as at October 2001)

Environmental Consideration	**Primary Constraints**
M1 – Proximity to landfill	Does the development proposal lie on or within 250m of a landfill site?
M2 - Land Instability - S1 Undermining - S2 Gypsum Dissolution - S3 Proximity to unstable land	S1- Does any part of the site lie within a Coal Mining Consideration area? S2 – Is the site located within a Gypsum Development Control area?

- S4 Radon hazard	S3- Is the application within an unstable land development control area? S4- Does the application area lie within a radon-prone area ?
M3 – Contaminated Land	1. Is the development proposal site on or adjacent to land that has been classified as statutorily contaminated? 2. Is the development proposal site known or suspected to be contaminated? 3. Is the development proposal site located in or adjacent to a current or past land use that could give rise to contamination?
M5 – Flood Risk	1. Is site within an indicative flood plain? 2. Is site within an historic flood plain?
M6- Designated Areas (nature conservation designations)	Is the proposed development within or partly within or closer than 100m from an area designated for nature conservation?
M7- Hedgerows	Will any hedgerow be removed, disrupted, split or altered in any way?
M8 – Greenbelt	Is the proposed development in a Green Belt?
M9- Bio-diversity	1. Will the development build upon or be within 100m of semi-natural or natural habitat? 2. Is the proposed development outside the boundary and >100m from the outer boundary of a priority habitat? 3. Are any species of conservation concern found on the site or use the site temporarily (e.g. for a few months a each year) during their life cycle? (e.g. for feeding, over-wintering, breeding)

M10 – Heritage	1. The planning proposal is not in an area of Designated Archaeological importance? 2. The planning proposal is not in a World Heritage Site? 3. There are no scheduled monuments on or adjacent to the site? 4. The planning proposal does not affect a listed building or structure? 5. The planning proposal is not in a conservation area? 6. Do any tree preservation orders exist within or adjacent to the proposed development boundary? 7. Are there any SSSI's or RIGS within or adjacent to the proposed development boundary? 8. Is the development proposal within a Battlefield, Historic Park or Garden?
M11 – Air Quality	1. Is the application for an industrial development? 2. Will the development increase SO2 above LAQM limits? 3. Will the development increase NO2 above LAQM limits? 4. Will the development increase O3 above LAQM limits? 5. Will the development increase 1,3 Butadiene above LAQM limits? 6. Will the development increase Lead above LAQM limits? 7. Will the development increase PM10 above LAQM limits?

Primary constraints are:

- The only constraints checked at the pre-planning stage.
- The constraints, which, if not satisfied, trigger the more detailed investigation described in the appropriate flow chart.
- Mostly able to be checked automatically using GIS techniques and data.
- An important input to the strategic planning process where standard policies may be modified to meet local needs.

Pre-planning applications

Pre-planning applications include general and detailed enquiries by members of the public, developers and professional advisors, with regard to a possible development. This process is illustrated below in Figure 4.2 and 4.3, from a perspective of evaluation of environmental considerations. The Context diagrams presented here are an IT systems design overview technique where the process under discussion is represented as a single process box with surrounding flows. The Data Flow Diagrams represent the information flows external and internal to a process being described and may be decomposed into more detailed parts as in Figure 4.7 (lower).

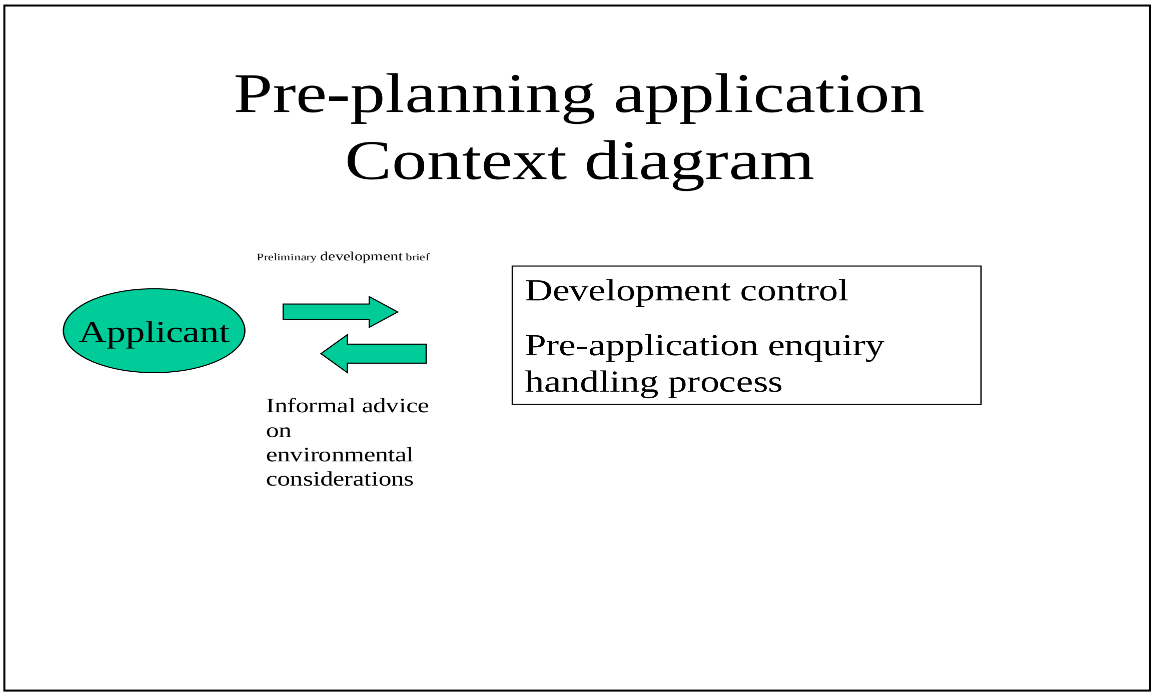
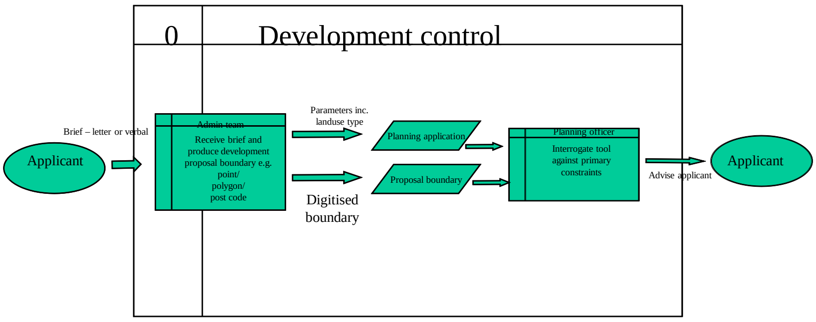


Figure 4.2 : Pre-planning application - context diagram

Both the Local Authority and the Environment Agency do not (currently, this may change) charge a fee for responding to pre-planning enquiries, therefore a quick method for responding to these enquiries is required in order to achieve 'best value' within local government.

Pre-planning application
Data flow diagram



- Generate a dated record of the pre-planning enquiry and response.

Planning applications

Planning applications are formal documented, detailed requests by members of the public, developers and professional advisors, for permission from the planning authorities to proceed with a development. The processing of applications involves a number of parties, with the main area of activity being in the development control department of the local authority. In all cases, the main requirement for the local authority is to ensure that any development conforms with statutory and regulatory controls, primarily the T&CP Act 1990 and the Environment Act 1995. Local authorities periodically produce a Development Plan for their area – this includes a Structure Plan, a Local Plan or Unitary Development Plan (UDP), and Minerals and Waste Plans. These outline how the local authority will meet planning guidance requirements and other legislative controls in their area, and include specific local policies and forward planning policies. For example, the restriction of certain types of development due to conservation status in a local area or the allocation of land for suitable end uses. All planning officers use these documents as their main source of guidance in preparing a recommendation to the Planning Committee for any given planning application. The final planning decision by the Planning Committee, however, can also be influenced by objections raised by the general public, statutory controls, conditions or recommendations imposed or suggested by external consultees e.g. Environment Agency, English Heritage etc. The Planning Inspectorate can also change planning decisions, following a review on appeal arising from a rejected application. This interaction is illustrated in Figure 4.4.

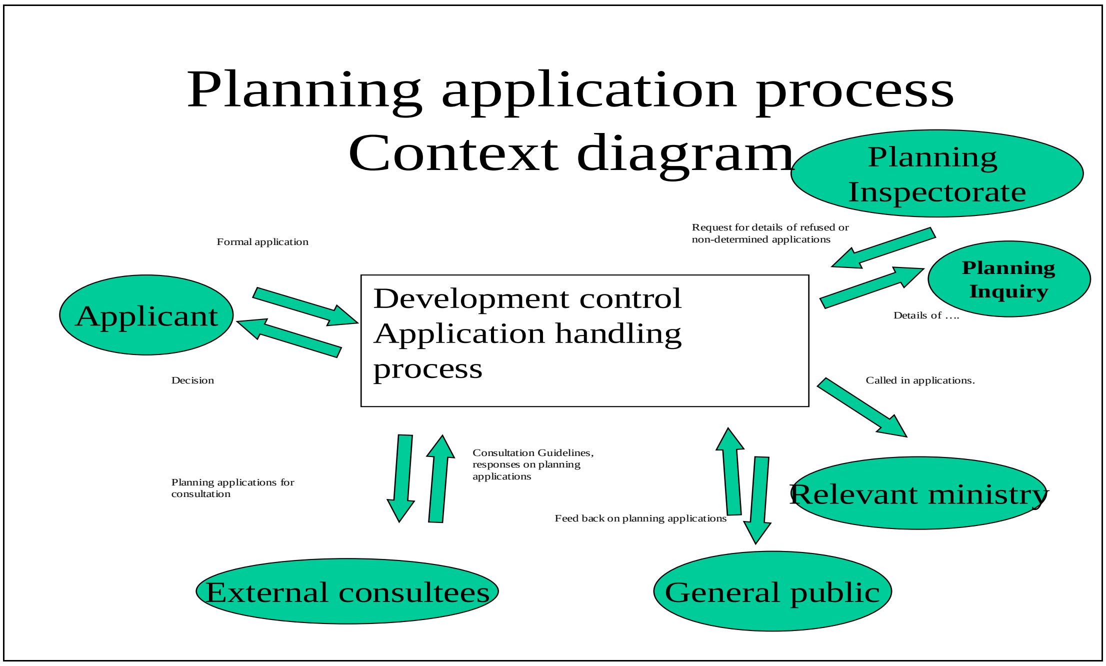


Figure 4.4 : Planning application processes – context diagram

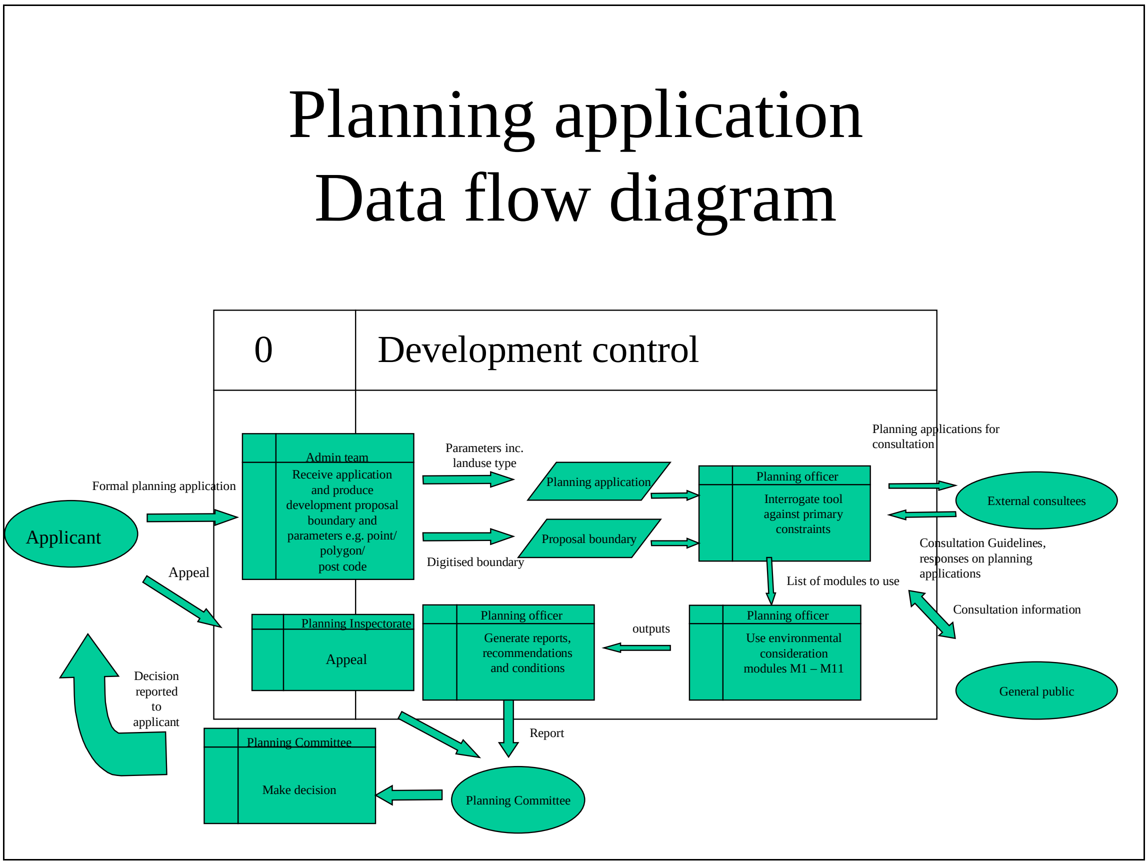


Figure 4.5 : Planning Application – data flow diagram

Figure 4.5 illustrates the processes that occur within development control to reach a decision on a planning application. For the purposes of this project, the process is limited to the consideration of environmental aspects of the proposal.

Interviews with the local authorities have suggested that the final planning recommendation rests with the Planning Officer. Therefore, the system should not aim to automate decision making, simply facilitate the provision of information to support the required decisions i.e. it should be a tool. With respect to supporting the environmental aspects of planning applications, the system should:

- Enable the entry of a land polygon depicting the proposed development area, or other *standard* reference point

- Allow the user to enter and edit a number of variables pertinent to the environmental consideration decision flows (to be defined), along with variables that describe and log an application
- Help the user check the application against the primary constraints, possible via automatic interrogation of relevant data
- Help the user check the application against environmental considerations
- Flag the external and internal consultees that need to be notified regarding any environmental consideration
- Provide the best data or models available (or links to such) to meet any specific question or process required within the decision process
- Generate reports that include planning recommendations, conditions and informatives
- Allow the user to have a record of the application process through the EISP tool
- Allow the user to re-enter the system at any point because a) there are processes within each environmental consideration flow chart that require the process going off-line i.e. waiting for an external response/result which needs to be returned to at a later physical date b) individual planning officers will require different amounts of detail or different sections of the flow logic according to their individual knowledge and working practices and the information in the application being processed

Strategic planning

Strategic Planning is the forward development planning process conducted within local authorities. It produces Local Plans, Structure Plans, and Unitary Development Plans that, once adopted, form the strategy for a local authority over a future period of time, usually between five and ten years. Waste and Minerals Plans, Air Quality Management Plans and Strategic Environmental Assessments (amongst others) are intermediate documents for strategies in specific environmental areas, which inform the structure plan process. Strategic Planning is usually a separate function to the development control process. The influences on strategic planning function are illustrated in Figure 4.6 and Figure 4.7. Figure 4.7 is expanded to provide a schematic for data flow during the local plan development process as an example.

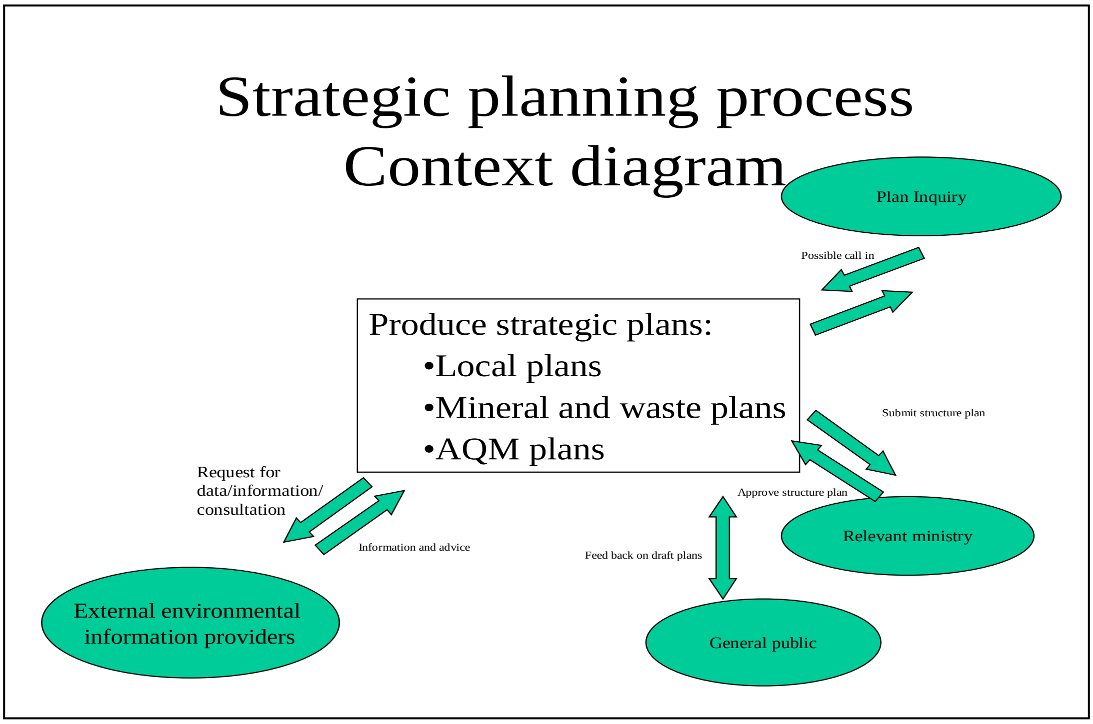


Figure 4.6: Strategic Planning – context diagram

Interviews with local authority representatives have given the project the overview that strategic plans are currently constructed from a number of sources of information. Planning guidance and statutory controls provide the framework for the documents. Environmental information is also interrogated both in the form of previous planning decisions (which help define changes in boundaries of previous plan land use allocations) and spatially for areas which would limit and constrain development, due to a particular attribute or feature. An overall constraint map is produced using this 'sieve ' method, which results in a map with 'gaps' where the planner may consider suitable development allocations or develop improvement strategies. This process may be very specific, i.e. for constructing a specific plan such as an air quality management plan, or broad in content as is required for the local planning, as illustrated in Figure 4.6.

A local plan is usually divided into several topic areas e.g. housing, employment, environment, education, etc., reflecting council responsibilities and objectives within the remit of the planning function and other local authority departments. It presents an overview of strategy and policies applicable within the area for the next plan period (up to 20 years). In constructing the plan, not only does the local authority have to establish how national planning guidance would apply in the local authority via specific policies, but a considerable part of the local plan construction procedure is spent upon determining the need for future development, in terms of:

Housing provision

Economic development potential

Provision of social facilities such as community centres, schools and residential care, etc.

Access to open green space and parks, etc.

Infrastructure and transport networks and facilities, etc.

Therefore, a great deal of information is compiled in order to examine the implications and outcomes of proposed strategies and policies, before the plan is put into practice. For example, consider that the local authority may be required to provision for a 5% increase in new housing stock within the authority for every 5 year period within the next local plan. First the strategic planning team would predict, given assumed housing densities, how much area would be needed to provide this requirement. Secondly it would construct a constraints map of information which would show where the development could not take place. This would include:

Existing developed areas in use for housing, industry, education etc.

Areas within the local authority that had poor transport access.

Areas with environmental terrain that was unsuitable for housing e.g. flood plains, steep slopes, nature reserves, contaminated land, etc.

Spatially this would leave a series of areas that could be considered for housing development. In order to refine the selection of appropriate areas, the strategic planning team would examine each area closely, again by compiling data and information into maps, in order to prioritise the most suitable areas in terms of local policies for:

Proximity to transport

Proximity to employment

Proximity to shops and other services

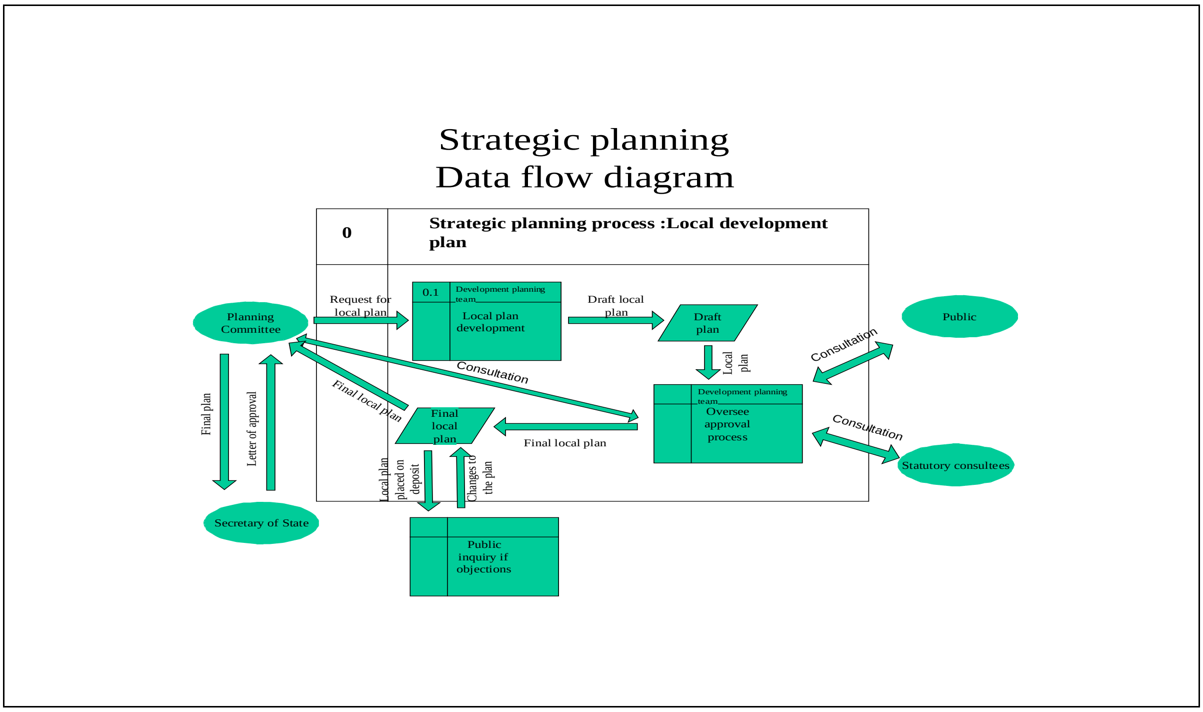
Proximity to social infrastructure

This would result in a limited number of choices of site suitable to accommodate future housing needs, with some indication of a hierarchy of the suitability of sites. The local authority would then allocate sites for new housing development within its local plan.

Similarly, the local authority will have policies applicable to specific areas of environmental information, such as designated areas, bio-diversity, air quality and waste and minerals planning. In some cases, it is necessary to produce individual plan documents for these considerations e.g. waste and minerals planning. As in the production of the local plan, waste and minerals strategic planning would, in terms of waste management:

- Predict future need for waste management facilities, whilst considering policies for minimising waste etc.
- Compile a 'constraints' map of where waste management facilities already exist and where facilities would not be permitted to exist
- Interrogate other information in order to ensure that siting of facilities does not conflict with any other policies and local plan allocations
- Select a number of alternative sites that could be used for waste management facilities
- Conduct various 'what if?' scenarios for different waste management strategies e.g. incinerator versus landfill; more recycling points to minimise waste for landfill etc.
- Conduct / comply with any statutory requirements concerned with site selection e.g. public consultation
- Allocate facilities to meet predicted waste management needs over the next local plan / waste minerals plan period.

Clearly, the strategic planning function is a complex and integrated process. It combines a great deal of environmental and other information within the decision making process, by applying forward planning requirements with respect to planning policy and guidance in the local context.



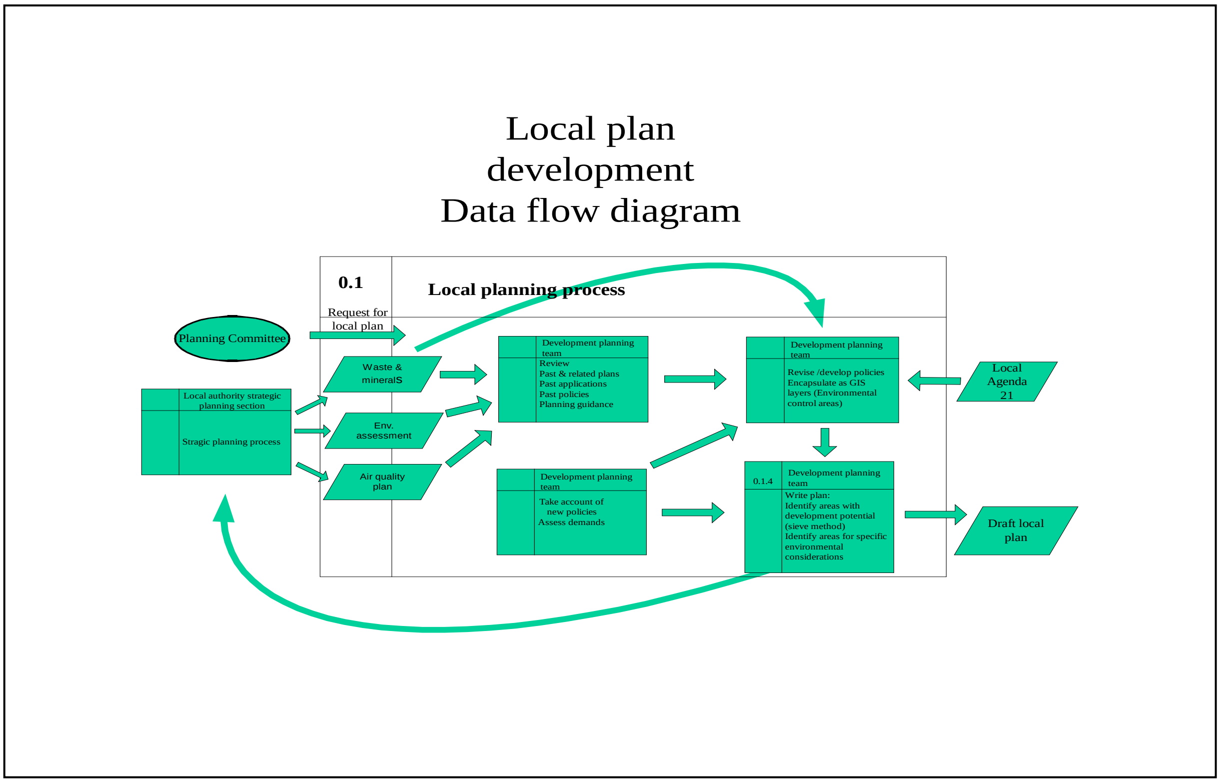


Figure 4.7 : Strategic Planning data flow diagrams expanded for Local Plan example

Table 4.3 : An illustration of where environmental information (highlighted in green) is used in Strategic Planning

Mineral and Waste Planning	**Air Quality Management Planning**	**Local Planning**
Geology	Bio-diversity	Air quality
Groundwater	Green heritage	Bio-diversity
Land instability	IPC regulations	Contaminated land
Proximity to landfill	LAPC regulations	Designated areas
Proximity to residential areas	Meteorology	Existing land uses
Transport	Proximity to residential areas	Flood risk
	Transport	Greenbelt
		Groundwater
		Heritage
		Historical land uses
		Land instability
		Past and current local plans
		Past planning applications
		Proximity to landfill
		Topography

From the perspective of supporting strategic planning, the system should be able to:

- Access past planning application decisions.

- Access pertinent environmental information from past planning applications, such as the planning decision and related environmental considerations.
- Access environmental data layers pertinent to the production of strategic maps and plans – these are likely to be primary constraint layers from the planning application system, with the addition of more specialist layers from the development control system.
- Provide an ability to synthesise adjacency issues, i.e. flag issues in neighbouring areas.
- Model cause and effect over an area, e.g. flood risk, air quality – these may require some specific development planning flow processes involving specialised models/model results.

Summary flowchart of the planning process

Figure 4.8 summarises the project team's understanding of those parts of the planning process that involve environmental issues and require environmental data, predictive modelling or expertise for their resolution.

The figure shows the three processes of strategic planning, handling pre-planning enquiries and handling planning applications. It illustrates how both pre-planning inquiries and planning applications are tested against the primary constraints and how, if the primary constraints indicate an issue, then planning applications are further examined using the flow chart or 'modules' M1 to M11.

This is the overall process that the EISP project concluded that it would aim to support. The following section defines the functionality requirements required to attempt to achieve that support.

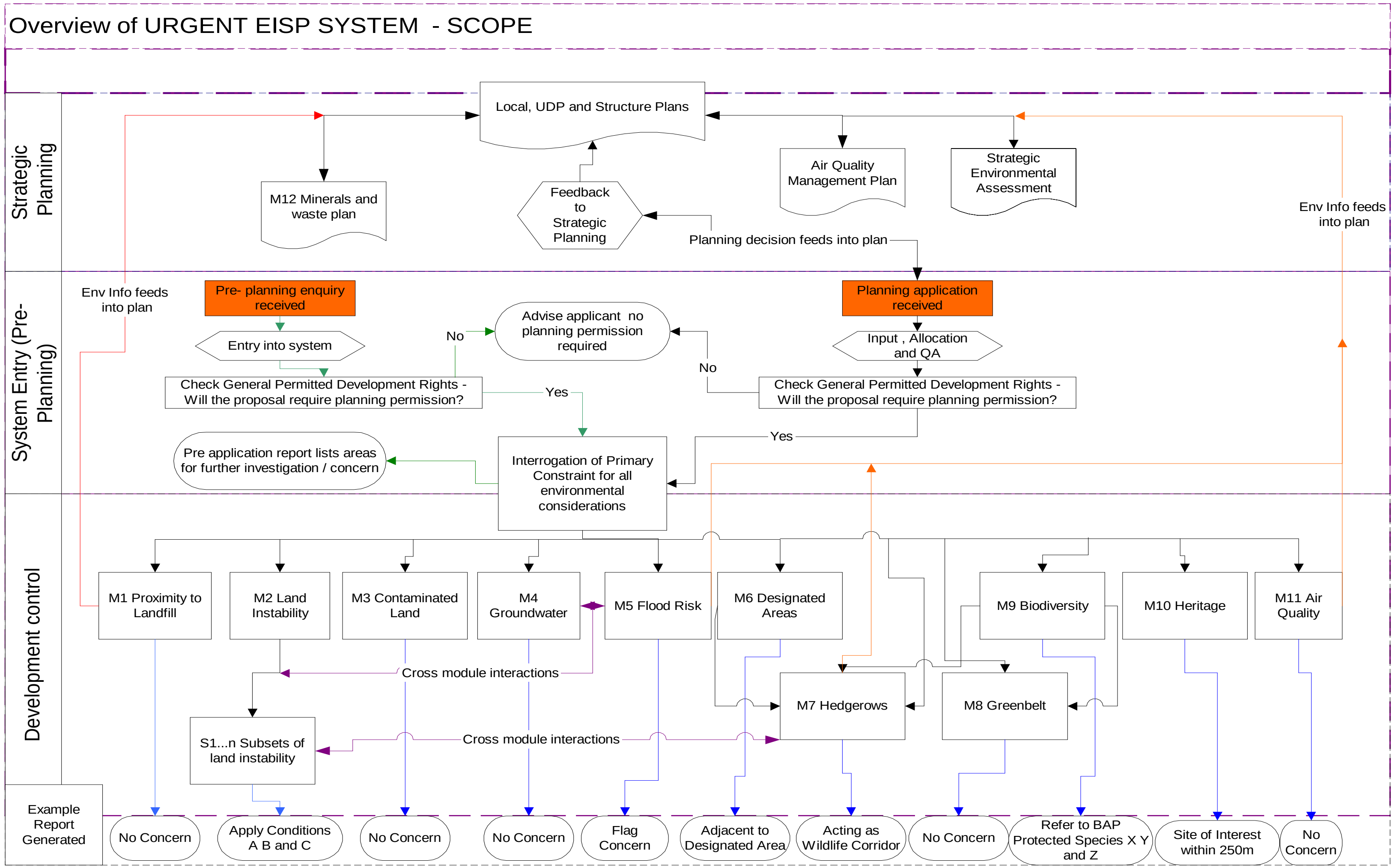


Fig 4.8 : Scope of the proposed EISP

4.4 Functional Requirements

The identified initial functional requirements are listed in this section (from Duffy at al., 2002).

4.4.1The pre-planning enquiry facility

So that the responsibility and reasons for decisions can be traced, it is a requirement that inquiries are recorded and stored in a database. These records also provide source of useful information when local plans are revised.

Pre-planning enquiry data

The system should record the following information about pre-planning enquiry:

- Enquiry ID
- Date/time of enquiry
- Inquirer's name and title(First, last and initials)
- Organisation (if relevant)
- Inquirer's address
- Inquirer's telephone, fax, mobile and email
- Site address including post code
- Site NGR
- Site polygon
- Notes about the enquiry
- List of environmental issues raised by primary constraints
- Date/time action taken
- Action taken
- User ID of officer handling the enquiry

Only the enquiry ID and one of site address, site postcode, site NGR and site polygon are mandatory.

Pre-planning enquiry tracking

The system should record the following information about a pre-planning enquiry as it is processed:

- Enquiry ID
- Primary constraint(s) of module (PC or M1 to M11)
- Step in processing
- Stage in processing step (Waiting to start, waiting on reply from X, completed, etc)
- Outcome of step
- Notes
- User ID of officer handling the enquiry
- Date enquiry input and last visited

Data Input and editing

Most inquiries are received by telephone and an appropriate method for capturing the key points made in the call is required. The essential information is the location of the site to which the enquiry relates and it should be made as easy as possible for the officer to identify this from the often imprecise information that the caller will give.

The requirements for data capture and editing are as follows:

Capture and editing of pre-planning inquiries

A facility should be provided to allow users to enter and edit the details of pre-planning inquiries. The edit modes should include:

- Add a new enquiry

- Update an enquiry (if the user has the necessary access permission)
- Delete an enquiry (if the user has the necessary access permission)

The officer should be able to capture the site's position either as a post code, a single NGR or a polygon. This information should be able to be entered as text or by free hand digitising on a map background. Addresses for which post codes are given should be checked against address files. There should be a facility for listing the addresses in a post code, selecting an address from the list and pasting it into the input form. There should be a facility for bulk deletions based on a date range.

Searching for pre-planning inquiries

The facility should include a simple search mechanism to allow the user to find an enquiry. Searches should be possible by any item of data and should allow wild cards on text searches. Polygon searches are desirable.

Usage

The capture and edit facility should ideally be designed for use during telephone conversations.

Browsing queries

Sometimes searching queries will not yield the required enquiry and it will be necessary to browse to find the relevant enquiry.

Browse facility

A simple spreadsheet listing of inquiries in the database should be available with the following facilities:

- Scroll
- Hide/resize/reveal columns
- Filter on column values (including date range)
- Sort by up to four columns

- Print (currently displayed data)
- Save to file (currently displayed data)
- Copy/paste

It should be possible to switch from browse mode to edit mode.

Checking the enquiry against the Primary Constraints

When the minimum enquiry details have been entered and validated, the system should convert the locational information into the best approximation of a polygon describing the site. This polygon should be used to search the appropriate environmental datasets and obtain the answers to the primary constraint questions.

Primary constraint tests

The system should be able to perform the primary constraint tests using GIS techniques and for each test return a result. On completion the system should return a summary listing of the environmental considerations raised by the enquiry. The results should be stored in the database and cross-referenced to the enquiry by a unique Enquiry id created when the enquiry is first entered into the system.

Repeating the Primary Constraints check

It should be possible to repeat the test at any time.

Handling missing data

The system should be able to handle situations where either a data set is not present in the GIS database or is present but incomplete in the area of the query. This information should be returned in a way that enables reports to be correctly annotated.

Reports

Enquiry report

It should be possible to create a report of the details of an individual enquiry and the result of testing the primary constraints. It should be possible to print the report. The printed version of the report should have the same information content as the screen report but should be formatted as a printed report suitable for sending to the inquirer.

Saving reports

It should be possible to save the report to file as a simple text document from the Access database record.

Copy and paste

It should be possible to copy and paste all of or extracts from reports to other documents.

E-mail

It should be possible to e-mail or fax the report direct to the inquirer.

4.4.2 The planning application facility

Planning application data

The system should record the following information about a planning application:

- Application ID
- Date/time of received
- Applicant’s name and title(First, last and initials)
- Organisation (if relevant)
- Applicant’s address
- Applicant’s telephone, fax, mobile and email
- Site address including post code
- Site NGR
- Site polygon
- User ID of officer handling the enquiry

- Size of development
- Land use proposed
- Status
- Notes

Planning application tracking

The system should record the following information about a planning application as it is processed:

- Application ID
- Primary constraint of module (PC or M1 to M11)
- Step in processing
- Stage in processing step (Waiting to start, waiting on reply from X, completed, etc)
- Outcome of step
- Notes
- User ID of officer handling the enquiry

Data input and editing

All as for pre-planning inquiries except that the data will be planning application data.

Searching for planning applications

All as for pre-planning inquires except that the data will be planning application data.

Usage

- The capture and edit facility should be designed for use in two modes:during telephone conversations
- and bulk input and editing from paper forms

Browsing applications

All as for pre-planning inquiries.

Checking the enquiry against the Primary Constraints

All as for pre-planning inquiries. The checking of the Primary Constraints should be displayed graphically. This could possibly be in the form of a flowchart in which progress and the results are displayed by highlighting the process and decision boxes in different colours as the process progresses. If no environmental considerations are raised then a report to that effect should be displayed.

Detailed checking of environmental considerations

If one or more environmental considerations are raised then, say, the flowchart should be dynamically extended to represent the relevant modules M1 to M11. The system should then move on to process these in turn asking for user input where the process cannot be automated. At such points it should be possible to suspend processing to obtain off-line information. It should be possible to resume checking at a later data in another session. It should be possible to interrupt the process at sensible points in long procedures and resume later. It should be possible to restart the process.

Design for change

The planning regulations are in a continuous state of flux responding to changes in the needs of society. The system should therefore be designed in a modular way so that changes to the primary constraints or modules M1 - M11 can be accommodated without the need for a complete system rewrite.

Modularity

The system must be written in a modular fashion with particular attention being paid to the design of the modules for handling primary constraints and modules M1 – M11.

Reports

The system should be able to produce a range of reports on individual applications and summarising past applications. These reports should include charts and maps where appropriate.

General reporting requirements for planning applications

All as for pre-planning inquiries.

Individual application report

Showing the state of where a particular application enquiry has got within all the flows and any final results if finished,

Planning application status report

A record of the final planning recommendation made by the planning officer to the planning committee (probably text cut and pasted into the database).

Storing of report information

The reports will be held within the system's database and each report will be presented on the web interface in such a way that the user can download a text file to his local machine and /or cut and paste it into a local document as well as print it locally.

4.4.3 The strategic planning facility

Copies of relevant data layers at a variety of scales will be available from the pre-application and planning application sub-systems. This will include the predecessor strategic plan land use allocation as GIS layers and a few environmental constraint layers from the topic modules that are specialised for development planning. Examples of the latter may be layers to help air quality issues plan strategic tree planting and in the minerals and waste planning parts of development plans.

Data Input and editing

GIS layers in the form of sets of polygons may need to be read in as data layers in exactly the same way as a planning application's polygons are in the planning sub-system. However, what-if? edit changes to polygons with additions/deletions may also be necessary.

Browsing queries

Past planning application decisions affecting the boundaries of existing and new land-use allocations will need to be available to the system. This may be in the form of records from existing historical planning systems in the Local authority or the records created by the EISP system itself. Data from these existing systems may need to be typed into forms for the EISP strategic planning system.

Identifying areas with development potential

Areas of land use allocation will be identified by sieving (GIS overlaying) between current land allocations, proposed changes to those allocations and taking into account the various identified relevant environmental constraints.

Reports

The strategic planning modules will produce recommended land use allocation and strategic intent GIS maps that are the result of GIS overlays and modelling.

4.4.4 Environmental data handling

The system must be able to store the following types of environmental information in a form suitable for rapid access:

- Flood plain maps
- Large scale topographic maps
- Detailed environmental topic specific maps

Data Input and editing

No facilities are required for editing baseline GIS data, but there is a requirement to be able to import data in standard formats such as Shape files. All GIS layers or databases should be stored with suitable metadata covering data provenance (e.g. name, owner, copyright information etc.) and data quality. The latter to include a statement on data accuracy, resolution, completeness and where relevant confidence levels using standard metadata schemas such as produced by NGDF, BGS, ISO standards etc. Such metadata should be available on request via the user interface so that at each stage of the system the user can call on the metadata on datasets being used at that time.

Importing GIS data

The system should be able to import raster and vector data from ESRI files.

Browsing GIS data

Whenever map information is displayed, the user should be provided with a basic range of GIS tools for navigating around the map.

GIS tools

The following GIS tools should be provided when map data are displayed:

- Locator window (Window locating the main display in a broader context)
- Pan and Zoom facilities:
- Zoom in
- Zoom out
- Zoom to scale
- Zoom to feature
- Zoom to current layer
- Pan
- Pan to grid reference
- Pan to post code
- Pan to address (desirable)
- Move layer:

- To front
- To back
- Forwards
- Backwards

Display of enquiry and application data on a map background

It should be possible to display pre-planning application inquiries and planning applications as symbols and polygons overlaid on a map background. The user should be able to select an enquiry or application and view or edit its details.

4.4.5 User interface

The user interface should be designed for staff who are familiar with packages such as Microsoft Office and the internet but should not require sophisticated computing knowledge or skills beyond the ability to digitise a polygon boundary, understand a map and interact with web pages.

Interface style

A conventional web interface style is required where the emphasis should be on simplicity and ease of use and the minimising of error. Decorative graphics that do not contribute to the objective should be omitted.

Error checking

The interface should be designed to detect user input errors, for example:

- format errors (masks should be used wherever possible)
- data type errors
- range checks
- permitted values

Where possible the interface should be designed to minimise the opportunity for errors by offering lists of valid options or buttons, rather than requesting user ‘free form’ input.

Error reporting

Errors should be reported to the user in plain non-technical English and, wherever possible, should be accompanied by hints as to how the error can be corrected.

User feed back

Whenever a process could take a long time in interactive terms the system should provide positive feedback on what it is doing and that the system has not hung.

User prompts

Whenever user input is expected, a prompt should be given indicating that the system is ready. If specific action is required the prompt should indicate what that action is.

4.4.6 Multi-user capability

The proof of concept version of the system is only intended for use in the five participating authorities and by NERC.

Concurrent usage

The proof of concept version should be capable of handling up to 10 simultaneous users i.e. proposed maximum imagined possible simultaneous use of the system is two local authority staff members from each of 5 local authorities.

4.4.7 Customisation

No customisation facilities are required in the proof of concept version. However, the design should be conceived to allow the future introduction of individual user customisation. The user settings should be able to be saved and restored when the user logs in. There should be default settings for all customisable properties. There should be an option to restore the default settings.

Planning for future customisation

The design should be conceived to allow the future introduction of individual user customisation.

4.4.8 Security and access control

The system should embody the concept of users and, for each user, should hold:

- User ID
- Name
- Password
- Address
- Telephone details
- Email
- Access permissions for functionality:
- Strategic planning
- Read
- Write
- Enquiry handling
- Read
- Write
- Planning application processing
- Read
- Write
- Access permissions to data

Login facility

The System should be accessed via a login facility which should request and check user names and passwords.

4.4.9 Audit trail

The processing of both pre-planning enquiries and planning applications may involve off-line processes such as consulting colleagues, external organisations and carrying out investigations. It will therefore be necessary to be able to break off from the system and return later, possibly inputting results from the off-line process. The system should also allow for continuation after natural breaks such as the end of the working day. It is also a requirement to be able to maintain an audit trail so that decisions and recommendations are recorded together with the information upon which they are based.

The system must maintain an audit trail as it passes each decision point in the modules M1 – M11. At each point it must store the data in Requirement ? and such other data as are needed to allow the system to continue at the point at which the process was interrupted.

Audit trail report

The user should be able to create an audit trail report for any enquiry or planning application that lists the course taken at any decision point together with relevant details.

4.4.10 Backup and recovery

As the web server will be outside NERC firewalls (to enable access by local authority staff) it will require independent and complete system and data backup in case of need of reconstruction on a virus free server.

Backup

A system should be provided that will enable the system administrator to make incremental and complete backups of the data base.

Recovery

A system should be provided that will enable the system administrator to restore the database to a previously saved state.

4.4.11 Referential integrity and data validation within the database

Referential integrity

The maximum use should be made of any referential integrity checking facilities within the database.

Data validation

The maximum use should be made of any in-built facility within the database for checking data values before they are stored, particularly:

- Specified values
- Range checks
- Inter field checks
- Data type checks
- Format checks

4.4.12 Performance

There are no performance requirements for the proof of concept version other than the design should be conceived around interactive use.

In practice the local authority pilots will require a decent perceived response and ease of use before they will even consider its technical helpfulness in dealing with the environmental considerations, as they are working in a very stressed and time constrained environment. This will have to be balanced against the time and resources available to achieve this sort of real-world production system. Ideally such refinements would be part of a production not prototype system but this system can only be tested in the planners working environment.

Performance

The system should be designed for interactive use.

4.4.13 Hardware platform

The system should have client server architecture. It should be designed to operate in an environment where the Web client is a standard PC of the type most planners are likely to have access to in 2002, say a, Pentium II with 400MHz processor, 128Mb RAM and 2Gb of available disk space. The web server will be a machine with a 1.4Ghz CPU, 512 Mbytes RAM and ample disk space and will be hosted in the demilitarised zone (DMZ) of the BGS protected by a firewall.

Operating system

The client side software should be able to run Microsoft Internet Explorer 5.5+ and connected to the World Wide Web with adequate bandwidth. The server side software should be able to run under Windows 2000.

4.4.14 Programming languages

The proof of concept version should be programmed in VB6 and web interface programming languages including javascript, html and AXL.

4.4.15 GIS

GIS software

For the proof of concept version the GIS software should be confined to ArcGIS 8.1 and ArcIMS 3.1 .

4.4.16 Database software

The database software should be MS Access 2000 (which is the same format as ArcGIS files) or SQL7/ORACLE if the former is found to be incapable.

4.4.17 Standards

No particular programming standards are required to be adopted for the proof of concept version beyond conforming to normal good practice - code should be neat documented and well commented.

The only exception to this general guideline is that manufacturer specific SQL and database procedures should be avoided so that the database can be upgraded.

SQL

No manufacturer specific SQL or database procedures should be used.

4.4.18 Development methods

Prototyping is acceptable as a development method i.e. continuous iterative improvement through piloting by different local authorities with feedback at each stage of development, along the lines of the Dynamic Systems Development Method Version 3 (DSDM Consortium, 1999).

4.5 Conclusions

In conclusion, an initial functional specification has been produced that combines a review of existing Decision Support Systems and UK planning related systems and a review by the planning authority partners of proposed, required and requested functionality features of a system designed by the research team. The functional design has been based on analysis of the planning legislation and guidance as written and as practiced by the partner local authorities combined with expert knowledge from the URGENT team (and other partners) on individual relevant existing datasets (Duffy et al., 2002, EISP, 2002, and Leeks, 2002).

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Chapter 5 Design and implementation of a web based EISP

5.1 Concept and function of the EISP

In the UK, the framework for land use planning is largely provided by the town and country planning system. This aims to secure the most efficient and effective use of land in the public interest, but also helps to make sure that development and growth are ‘sustainable’ - in other words, that planning decisions will not damage the environment for future generations. Implementation of planning policy is largely the responsibility of Local Authorities.

The increased emphasis on ‘sustainable’ development places greater responsibility on planning authorities to take a longer-term view of the likely impacts of decisions involving the environment. For example, the question of whether to allow development on floodplains must take account of the effect of global warming, which is predicted to give a rise in sea level of up to 0.88 m over the next 100 years placing at risk over 12 000 km^2 of low-lying land.

To inform such decisions, the planning system requires tools that link relevant science with the practical requirements of determining planning policy. The Environmental Information System for Planners (EISP) has been designed with this aim in mind. This ‘proof-of-concept’ system, developed in collaboration with five local authorities, is intended to make available to non-specialists models and information covering a wide range of relevant scientific disciplines, using the worldwide web as the access vehicle. It consists of 11 linked modules, relating to the following five environmental themes:

Table 5.1: EISP modules implementing environmental themes

Theme	Module
Atmospheric science	Air quality (particulate matter)
Ground stability of the shallow sub-surface	Shallow undermining
	Landslide susceptibility
Hydrology / hydrogeology	Groundwater protection
	Flood risk
	Drainage
Land quality	Land Contamination
	Proximity to landfill
Urban ecology	Biodiversity
	Natural heritage
	Man-made heritage

The system is designed around decision flow diagrams (one for each of the above modules) codified to take account of current planning procedures in the UK. Industry-standard web technologies have been employed to integrate the flows and develop the functionality that will allow the planner access to the system through secure web pages. Underpinning the system is an environmental GIS that contains the most up-to-date data, information and models relevant to each of the environmental disciplines listed. Because the planning regulations are subject to change, the system has been designed in a modular way so that new legislation can be accommodated without the need for a complete system rewrite.

The EISP has being designed to support three principal planning functions carried out by Local Authorities:

- Pre-planning enquiries
- Development control decisions, and
- Strategic planning

The operation of the system is illustrated schematically in Figure 5.1.

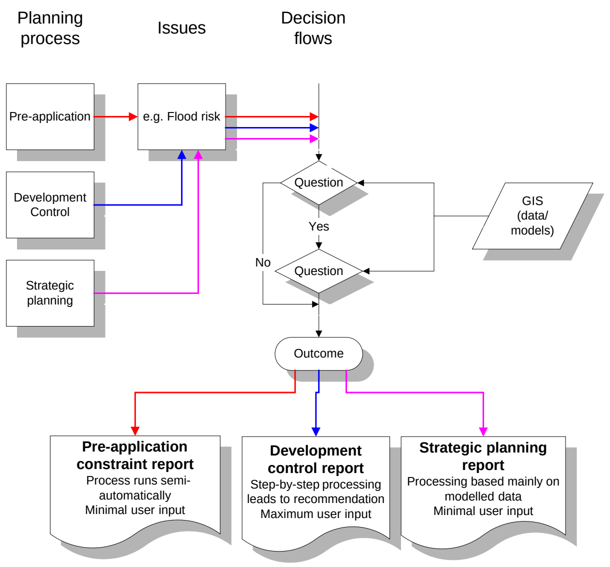


Figure 5.1 Outline of EISP operation (from Culshaw et al., 2006)

5.2 Overview of the system implementation

For the purposes of designing the EISP, the planning processes, legislation and planning guidance that planners follow have been translated into flow diagrams which break the decision process down into discrete steps. Each step may involve:

- a question
- interrogation of an environmental dataset or model, or
- consultation

As the planning regulations are in a continuous state of flux, the decision flows must be capable of rapid update to reflect changes in legislation and societal needs. The prototype system has therefore been designed in a modular way, so that changes to individual modules can be accommodated by substitution of individual steps, without the need for a complete system rewrite.

The overall design of the prototype EISP, incorporating the above three planning functions, is illustrated in Figure 5.2.

The **pre-application function** provides a means to identify rapidly the key environmental factors (*primary environmental constraints*) that may materially influence consideration of a planning application. This function is intended to help planners advise prospective applicants – perhaps in real-time over the telephone – of issues that, for example, may need to be addressed in a site investigation. The same facility, run on receipt of a full planning application, will assist in deciding whether EIA is required and, if so, will provide guidance in undertaking the necessary scoping study.

The **development control function** provides more detailed advice to planners, relating to the evaluation of those environmental considerations that may contribute to the final planning decision. The analysis is based on current planning practice, laid down in relevant Planning Policy Guidance Notes (PPGs) (now Planning Policy Statements). The system provides direct access to relevant datasets, model scenarios and scientific interpretations and indicates the points at which consultation with statutory bodies should take place.

The final advice from this function takes the form:

- Application complies with planning policy, statutory regulations and local plan policy - advise acceptance, or
- Application contravenes planning policy, statutory regulations and local plan policy - advise refusal

This advice is contained in a report, which can be retrieved at any stage. The report:

- details each step taken in the decision process
- lists the datasets and associated metadata used in any step, and
- identifies the relevant legislation or guidance

By this means, the system automatically provides an audit trail covering the entire decision process. Moreover, the operator has complete freedom to consider the different environmental constraints in any sequence and to interrupt and resume the process at any point in the cycle.

The **strategic planning function** uses modelled data to provide information at local and regional scale.

The underpinning data used to deliver each of the above functions have been assembled from Local Authority sources, complemented by suitable national reference material (including NERC's key environmental data holdings).

None of the functions is designed to operate as a 'black–box' Expert System. Indeed, it was an important design principle that EISP should not seek to supplant the professional judgement of the planning officer. Rather, the system is intended to be a transparent self-documenting tool that will assist the officer to reach a decision and to make a recommendation for acceptance or rejection. It is recognised that this decision will be influenced by many other factors in addition to the environmental considerations addressed in EISP.

The basis for this planning-support tool is a suite of logical decision trees, one for each of the thematic modules listed here. Figure 5.3 shows the structure of part of a typical decision flow. Textual aids for the user, such as relevant regulations, informatives and conditions, are included as links throughout the flow using the World Wide Web (www) paradigm.

In Figure 5.4, a screen-shot from EISP shows which of the 11 modules was implemented in each of the five collaborating Local Authorities. It should be noted that the decision flow for Air Quality PM_{10}'s was implemented in support of both strategic and development control planning in Wolverhampton and Glasgow; the landslip module was completed for strategic planning only in Telford and Wrekin. There is presently no strategic planning option for the remaining nine modules.

Figure 5.5 shows Screenshots from EISP, showing the system created for Telford and Wrekin council with all environmental topic modules implemented including the new Natural ground Stability (GeoSure) module. This system is described in detail in the EISP user guide version 2.2. in Microsoft Word form on the CD attached to the rear of the manuscript . This allows any reader of this thesis to get a detailed visualisation explanation of each flow in action and they therefore may not need to apply for a password to access the web-based system directly. Passwords for research purposes are available by application to the author as long as the system is maintained on-line.

The CD also contains the detailed Visio format logical flow diagrams (with free Visio viewer software for those without Visio) for all of the logical flows and a directory \testupload of all the test shapefiles (actual and designed for testing) of the planning applications polygons referred to in the user guide, so that a user with a password can run these examples themselves or provide their own shapefiles (which must be within the boundary of the Telford and District Council to be worthwhile).

Many e-government initiatives are encouraging local authorities to implement their services and functions using the www. Planning control is one such function and so the decision was taken to make the EISP available via the www. This has a number of distinct practical advantages. During the development phase, it has enabled development, trialling and testing to take place on one web-server, thereby minimizing the burden of providing software support across several geographically dispersed sites. Operationally, the approach facilitates access to distributed resources (including databases) through a common portal.

Having adopted the web paradigm, a set of industry-standard web technologies was employed to implement the system. The Coldfusion ™ Server tag-based web services from Allaire form the core of the interactive system and the Coldfusion custom tag capability was used to implement the modularity of the system. A custom tag with associated inputs, outputs and dataset action parameters represents each step of each flow. Re-use of such tags is encouraged through the use of a custom tag repository. This allows a flow diagram step to be changed by simple substitution of a tag with its tailored replacement.

A custom tag may require a GIS action to take place - Coldfusion then calls the ArcIMS ™ Internet Mapping Service from ESRI (Environmental Systems Research Institute Inc). This uses a database of urban environmental data layers which have been prepared for each module and customized for each local authority test area. For examplethe primary constraint question 'Is the application within 250 m of a landfill site?' is implemented through a call to ArcIMS. Here the planning application polygon, landfill site GIS layers and associated database attributes are combined in a GIS overlay. Some of the parameters, such as the 250 m limit, can be varied by the planning officer who may wish to model 'what-if?’ scenarios and deal with non-standard queries.

The EISP holds the urban environmental datasets, together with references to relevant planning regulations and planning guidance, in Microsoft Access™ 2000 databases. The actual texts may be held in the database or, where appropriate, links are included to URL addresses. A third Access 2000 database, termed the Tracking Database, maintains an audit trail for each planning application and is used to generate reports at any stage of the processing procedure.

The planner uses the system by accessing secure web pages. The process begins, either by entering basic planning application registration information and digitizing on-screen the outline of the site or by uploading pre-prepared information, which is often routinely captured by local authority in-house digital systems. The EISP then processes the information. Most primary constraint checking is done automatically through reference to relevant GIS data layers. The full planning application modules require user input as they follow the flow diagrams. Some steps may require the user to go off-line whilst external consultants are approached or specific environmental site reports examined and relevant responses extracted. The Tracking Database keeps a record of where each planning enquiry is in the system. Figure 5.6 is a schematic overview of the information technology components used in the implementation of EISP.

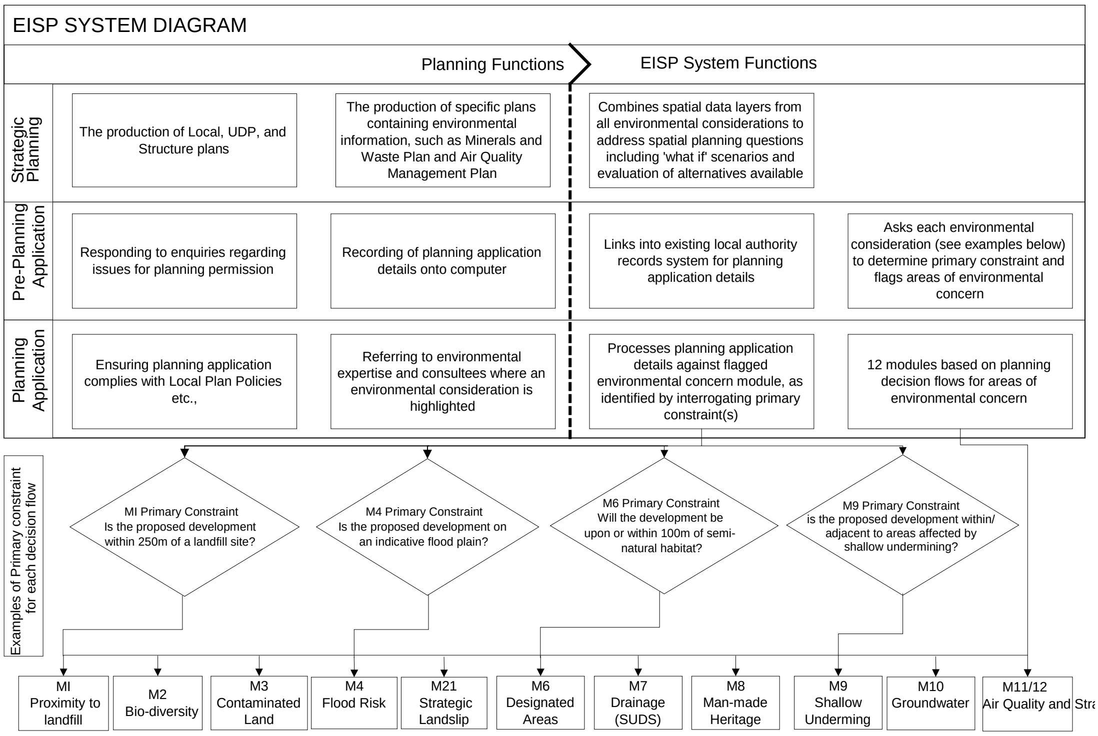


Figure 5.2: EISP overview diagram showing planning functions implemented in the EISP

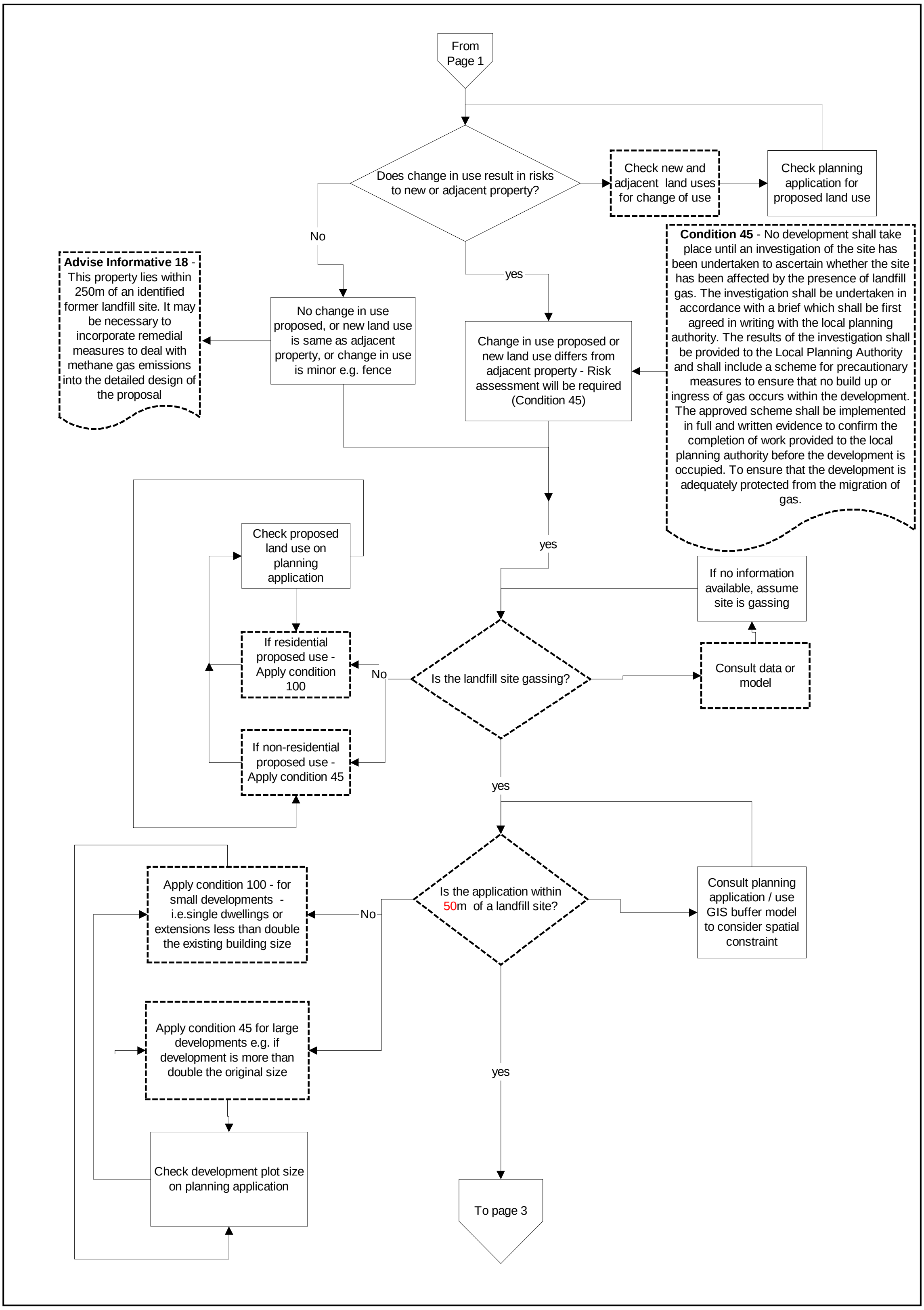


Figure 5.3: Part of logical flow diagram representing the environmental constraint ‘Proximity to landfill’ as defined by English planning regulations

Figure 5.4: Screenshots from EISP, showing which modules were implemented for which collaborating Local Authorities

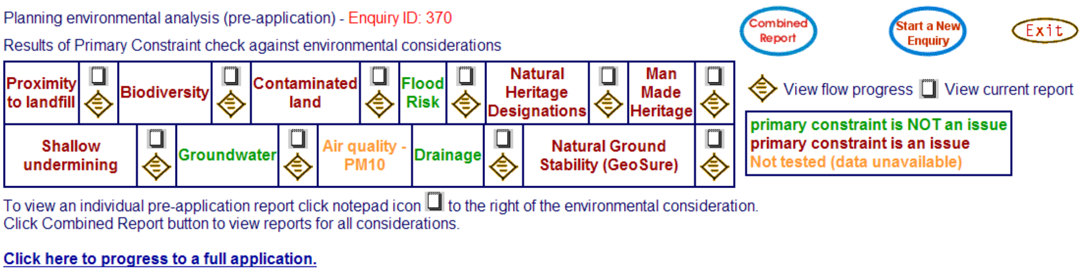


Figure 5.5: Screenshots from EISP, showing the system created for Telford and Wrekin council with all modules implemented including the new Natural ground Stability (GeoSure) module

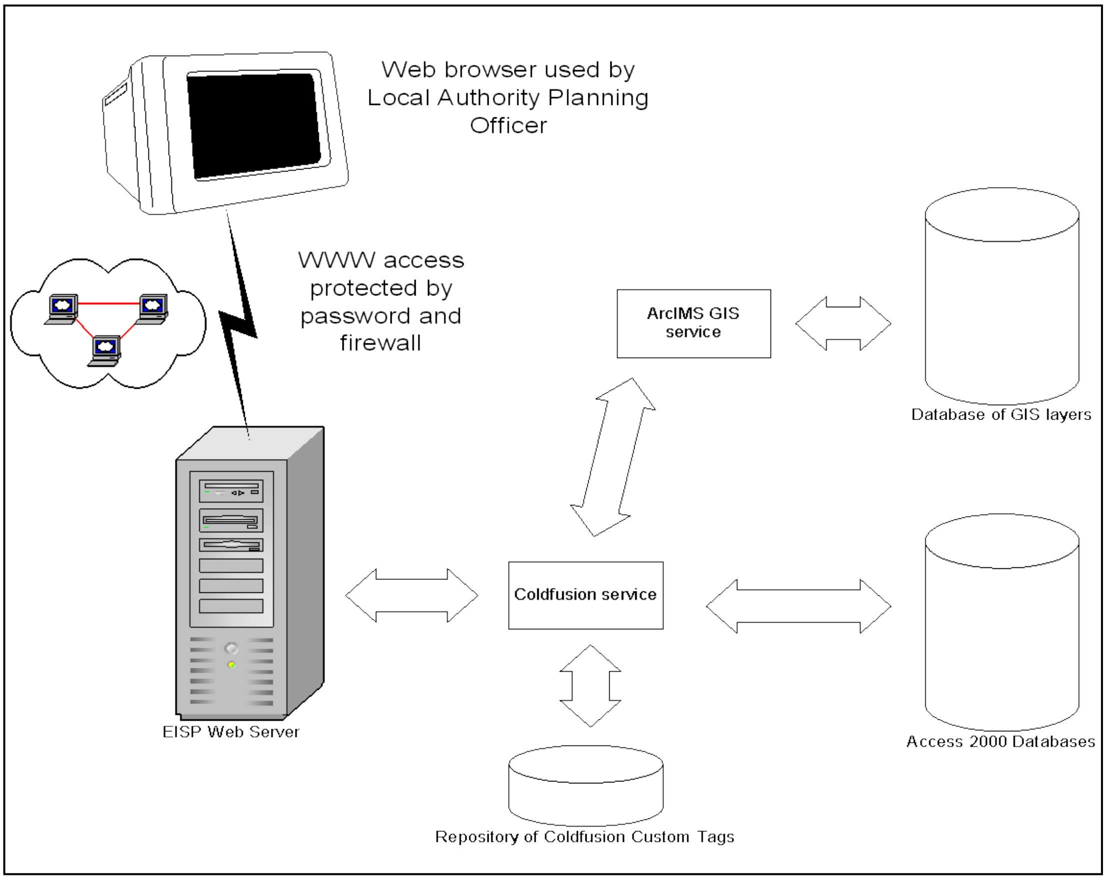


Figure 5.6: Information Technology used to implement EISP

(from Culshaw et al., 2006)

5.3 Conclusions

The design and computer application implementation of the detailed topic/legislation/guidance specific logical flow diagrams constitutes the major output from this stage of the research. The logical flows as implemented are not known outwith this work but nonetheless represent the intent of the published planning guidance. The system was implemented as a web system so that different local authorities (and other interested parties) could easily test it (chapter 6), given access, and this also avoided difficulties with installing test software within different councils.

Reference

CULSHAW, M.G., NATHANAIL, C.P., LEEKS, G.J.L., ALKER, S., BRIDGE, D., DUFFY, T., FOWLER, D., PACKMAN, J., SWETNAM, R., WADSWORTH, R. & WYATT, B. 2006. The role of web-based environmental information in urban planning- the environmental information system for planners; Science of the Total Environment, 360, 233-245.

Chapter 6 Testing the EISP by module and planning role

6.1 Introduction

The following sections provide an overview of each module; each description follows a common structure, covering:

- the thematic scope in relation to the planning context
- concepts and models used, including links to science base, and a critical review of these
- a critical review of the data used
- feedback and user reaction from the local planning authorities and others

6.2 Air Quality Module

Scope and Planning Context

The Air Quality Strategy for England, Scotland and Northern Ireland (DEFRA, 2001) sets objectives on eight different pollutants for protecting human health. The air quality module of the EISP focuses on the pollutant PM_{10} (particulate matter). Particles are generated from primary or secondary sources. Primary sources are carbon particles from the incomplete combustion of fuel, mining, quarrying, and from brake and tyre wear in motor vehicles. Secondary particles are formed in the atmosphere by chemical reaction or the condensation of gases, and sulphate and nitrate aerosols. A certain amount of particulate matter forms naturally, e.g.wind blown dust and sea salt, and biological particles such as pollen and fungal spores.

Under the Air Quality Strategy the limits for PM_{10} have been set as follows:

24 hour mean: 50 $\mu g/m^3$ not to be exceeded more than 35 times per year

annual mean: 40 $\mu g/m^3$

<u>by 2010</u>

24 hour mean: 50 µg/m^3 not to be exceeded more than 7 times per year; (London: 50 µg/m^3 not to be exceeded more than 10 times per year)

annual mean: Scotland 18 µg/m^3, Rest of UK 20 µg/m^3, London 23 µg/m^3

Throughout the EISP we have used these limits as our primary constraint (or test) for a development control application or for strategic planning. Once this primary constraint has been triggered the user works through a series of questions, often relying on user input, until the end of the flow is reached and a decision is recommended. Guidance for the air quality flows has come from PPG23 (table 2.1).

In addition to providing a mechanism for following planning decisions, a model has been developed that provides a tool for showing the ameliorating effect on increased PM_{10} (e.g. from new industrial processes) by planting trees across the whole of the local authority area.

Trees have been widely quoted as effective scavengers of both gaseous and particulate pollutants from the atmosphere. By calculating the potential planting locations in the local authority area, and assuming that all sites planted are of 'instant' mature woodland (10-15 years), the ambient concentration of PM_{10} is reduced significantly (Bealey et al., 2007). In this way, any new development that contributes to the background PM_{10} level can be mitigated by planting trees, and in some cases, reductions can be enough for the air quality limit for PM_{10} to be achieved.

Data and models utilized

The model used for decision support on air quality issues is FRAME (Fine Resolution Atmospheric Multi-species Exchange model). The model is a statistical Lagrangian multi-layered dispersion model which models the transport of air parcels over the landscape, simulating all the emission, transformation and deposition processes as it moves. The model uses meteorological inputs including rainfall and wind speed, emissions and land cover data sets. The Glasgow domain covers 60×50 km at 1×1 km grid resolution. To provide the boundary conditions for this fine resolution, urban modelled concentrations at the edges of the domain are provided by a UK model which has a spatial resolution of 5x5 km.

Feedback

The Air Quality module has been implemented to support decision making in respect of strategic and development control planning in Glasgow and Wolverhampton. Both authorities seem satisfied with the prediction of PM_{10} concentrations and the ability to model various tree planting scenarios, although it is unclear how many times the authorities had actually used the system. Glasgow council, who used the system for two days, observed that underlying air quality data changes year on year; the system currently has no facility to update information or supplement national data with local data and an operational implementation would need to incorporate both requirements. However, they confirmed that the flowcharts were an excellent tool to allow the user to understand the methodology and how this contributes to the relevant the decision processes.

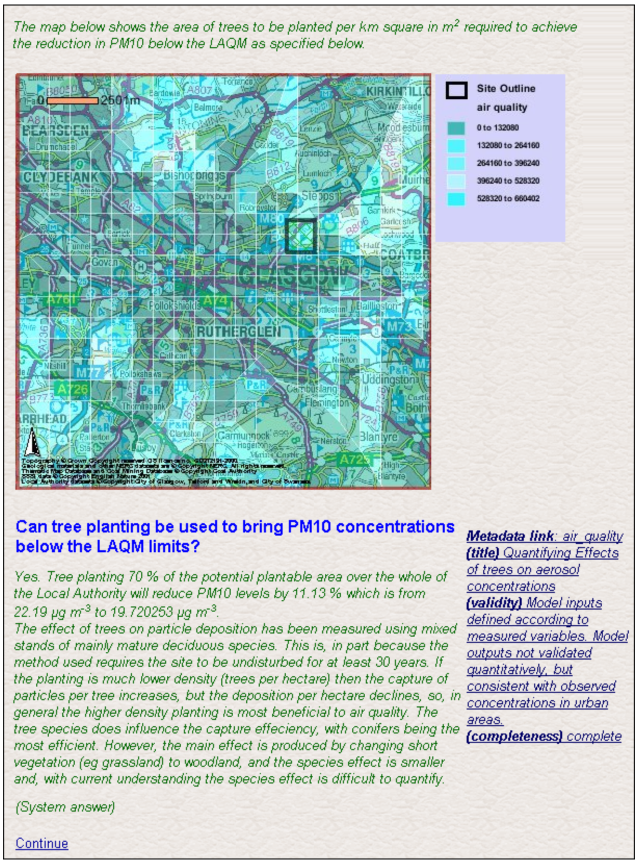


Figure 6.1 Use of the Air Quality module to suggest strategies to ameliorate the effects of increases in background PM_{10}

6.3 Natural Ground stability

Introduction

In the UK, incidents involving ground instability pose a relatively small risk to life and health. Nevertheless, the damage caused to buildings and structures as a result of ground movement is substantial, and costs to the insurance industry are currently running at between £300 - 500 million per annum (DETR, 2001).

National guidance on dealing with ground instability is set out in PPG14 (table2 2.1). This guidance sets out the broad planning and technical issues that local authorities need to consider in dealing with development proposals on unstable land. The guidance advises that local authorities:

- identify areas where subsidence is likely to be a material planning consideration
- establish policies to minimise the impact of subsidence in these areas
- indicate the additional information that will be needed in support of a planning applications in areas at risk from subsidence

The EISP incorporates two instability modules: one is concerned with the problems of development in former coalfield areas, which may be affected by shallow undermining; the other deals with the potential for ground to subside as a result of landsliding.

The modules have been developed in collaboration with the Borough of Telford and Wrekin in the West Midlands. The Borough covers parts of the Coalbrookdale Coalfield and the World Heritage Site of the Ironbridge Gorge, both of which are affected by stability issues.

6.3.1 Shallow undermining module (coal)

The subsidence problems presented by coal mine workings in the UK are fairly well known and are documented in Annex 2 to PPG14. They are mainly a legacy of extraction methods that, in some cases, date back several centuries, and commonly involve shallow workings.

Instability is generally triggered by progressive collapse of underground voids, mine shaft collapse or through subsidence on poorly compacted fill. In some instances, subsidence effects are caused by reactivation of geological faults, resulting in disruption to the ground surface and the formation of fault scarps. Recent research has suggested that one of the triggers for fault reactivation may be mine-water rebound following coalfield abandonment. In all cases, collapse may take place many years after mine abandonment.

In establishing a system to assess the shallow undermining hazard in a coalfield area, the following issues were considered:

- location of shallow workings or underground roadways (<50m depth)
- location of abandoned mine entries (shafts, adits)
- location of workings along a coal seam outcrop
- location of over poorly restored opencast sites
- position of faults with a history of, or potential for, reactivation

The degree of hazard presented by each of these hazards is difficult to quantify as large variations in ground conditions may occur even within a specific site. An additional complication is the uncertainty in location of many of the older workings and shafts, which were abandoned before it became obligatory in 1873 to compile mine abandonment plans.

Scope and planning context

The procedure for dealing with planning applications in areas where there is a legacy of coal mining is fairly well established. The Coal Authority defines Coal Consultation Areas and is a statutory consultee for all applications falling within such areas. The procedure followed by the Borough of Telford and Wrekin (Figure

6.2) illustrates the decision process in outline. More detailed flow charts based on case studies carried out in the South Wales Coalfield have also been published (Ove Arup and Partners, 1995) and have been adapted to form the basis for the logical decision flows incorporated in this EISP module.

An important element of the decision flow is the facility that allows the planner to impose conditions on any application to ensure safe development. In the context of shallow undermining hazards; this invariably involves a requirement for a site investigation or submission of a scheme of remedial works to be agreed before development begins.

Data and models utilized

Although mining records are lodged with many public and private organisations, the Coal Authority is the principal source of mining information and has a statutory responsibility to maintain and provide public access to its database holdings.

For the purposes of trialling the EISP, the Coal Authority has made available a GIS with thirteen component layers (Table 6.1). The information is derived from detailed plans but is presented in a more generalised format, based on a 0.5x 0.5 km grid resolution. This thematic database has the status of a research tool, and its continued development will depend very much on whether it satisfies the needs of local authorities and other intended users. In Figure 6.2, we have used the GIS to identify areas affected by shallow undermining within the Borough of Telford and Wrekin.

Table 6.1. Coal Authority thematic mining database

Coal Authority Thematic Data
Shallow underground coal working (less than 50m deep)
Coal seam outcrop
Possible shallow underground coal working
Shallow spine roadway
Licence area at the surface for underground coalmining
Worked-out opencast site
Licence area at the surface for opencast coalmining
Geological feature (fissure or breakline) [1]
Mine entry (shafts, adits)
Site investigation area
Surface hazard mining enquiry polygon [2]
Area for mining reports intervention [3]
Subsidence damage licence claim

[1] Fissures, breaklines and other coal mining-related lines of weakness at the surface caused by coal mining subsidence. They include existing fault lines activated / opened by coal mining operations

[2]Areas that have been the subject of reported incidents (shaft collapses, gas emissions, crown-holes, water emissions).

[3] Areas where the Coal Authority is aware of potential coal mining features (e.g. mine gas occurrence) but where details are not (yet) held on the coal mining database.

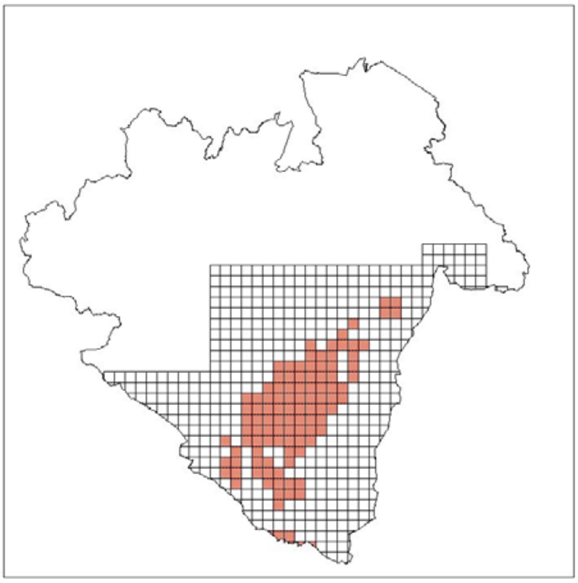


Figure 6.2 Areas of potential shallow undermining (shaded red) in the Borough of Telford and Wrekin

Feedback

The thematic GIS provided by the Coal Authority provides a useful first indication of the likely mining hazards in an area. However, for some development control purposes, more precise information is required on the locations of features that may present a hazard. In the case of Telford and Wrekin, this applies particularly in relation to:

- shaft locations
- position of the high wall in backfilled opencast workings

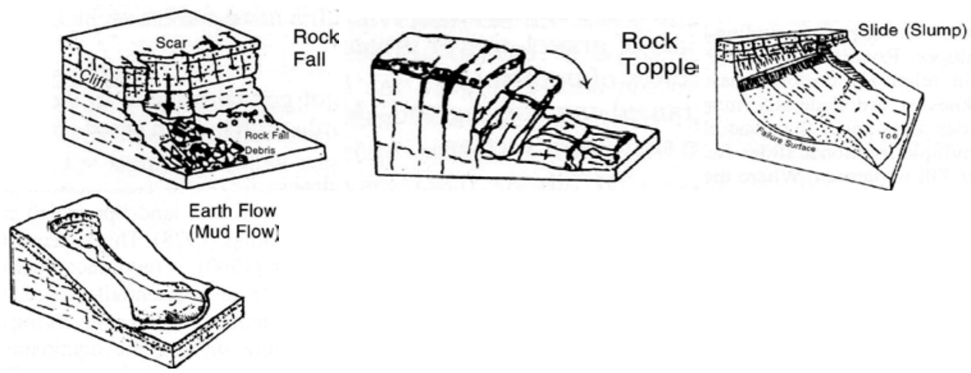
In the prototype, these issues have been partially addressed by incorporating additional information from Coal Authority abandonment plans and BGS databases.

Shallow undermining was implemented for Telford and Wrekin Borough but also tested by technical experts at Glasgow, who commented that the flow was comprehensive at the technical level, and would be very useful in generating in-house preliminary desk study reports for various council clients. Speed of access to the system and report generation were features that were especially commended.

6.3.2 Shallow geohazards and Landslide susceptibility module

Scope and planning context

A landslide is the outward and downward movement of rock or soil on a slope. This often takes place by falling, toppling, sliding, or flowing.



Recognition of a landslide hazard in an area may result from the existence of a previous landslide or from recognition of the presence of conditions that may predispose a slope to landsliding, such as a combination of adverse slope angle, geology and groundwater. This is not necessarily a cause for alarm as most landslides are ancient and enhance the landscape rather than threaten property and lives. If suitable advice and precautions are taken potential problems may be avoided.

First time landslides occur from time to time through natural causes such as unusually heavy rain, undercutting by rivers or the sea, or the weakening of rock as it weathers but more often movement is a reactivation of an existing slide.

Landslides may also be triggered artificially by excavations at the foot of slopes, saturating slopes by the disposal of surface water or loading slopes by dumping material on them. The movements started by such actions may be difficult and expensive to stabilise but could usually be avoided by taking expert advice at an early stage of project planning.

Annex 1 to PPG14 looks at the problems caused by landslides and provides advice to local authorities on dealing with this issue. The guidance advises:

- identifying areas where landsliding is taking place or that are susceptible to landsliding
- controlling or restricting development within these areas
- setting a local policy that identifies the criteria and information requirements for determining applications in landslide areas

Data and critical review

The landslide module within the EISP addresses the national problem of identifying areas susceptible to landsliding.

In the past, hazard assessment has often been based on a probabilistic approach, using the premise that if there have been many landslides in an area in the past then there will be many in the future. However, with the prospect of climate change and the fact that human activity and demands on the environment change through time, past events are not necessarily a good guide to future problems.

The EISP landslide susceptibility module employs a more fundamental method and uses a deterministic approach that looks at the presence of factors, such as slope, lithology and groundwater that increase the susceptibility of a given site to landslide activity. The causative factors that are present are assessed according to their relative importance in promoting landslides and combined in a GIS to give a plot of the relative susceptibility to landslide activity across the area. A high rating does not necessarily mean that landslides are present, have happened in the past or will do so in the future, but if conditions change through natural or artificial means and factors are added or intensify, then slope instability may be triggered.

The methodology used to create this assessment does not indicate the current slope instability at a site. It indicates the potential for such a hazard to be present and thus the relative importance of obtaining additional information when changes in land use are proposed. The additional information may require a site-specific assessment of the hazard or an investigation of the surrounding area to assess its impact on the proposed change or vice versa. Assessment may require some or all of the following:

- a desk study
- a site visit
- sampling and geotechnical testing of the materials beneath the site and/or its surroundings

The output from the module is expressed in terms of 5 Strategic Development Control Zones, the characteristics of which are in table 6.2.

Table 6.2 Characteristics of the 5 Strategic Landslide Development Control Zones

Landslide susceptibility zone	Significance
Zone 1	Susceptibility to slope movement is unlikely.
Zone 2	Slope stability problems could be present or anticipated. Normal site investigation procedures apply. Slope instability problems are not likely to apply to site but consideration to potential problems of adjacent areas impacting on the site should always be considered.
Zone 3	Slope instability problems may be present or anticipated. The Council may require the submission of a detailed ground investigation report, specifically considering the slope stability of the site. Some implications for stability of this site and/or adjacent area should be made if changes to drainage, construction or excavation are planned. Such a report must be approved by a qualified professional to the satisfaction of the Council Engineering Department. Development will not be permitted unless the Council is fully satisfied that the necessary engineering works will be carried out including arrangements for their subsequent maintenance.
Zone 4	Slope instability problems are probably present. Allocation of land-use in this zone must reflect the guidance given in PPG 14 that the council be satisfied that developments in such areas are designed with an adequate appreciation of the ground-stability issues and take into account relevant factors at the design stage. The Council will require the submission of a detailed ground investigation report, specifically considering the slope stability of the site and adjacent land as part of any planning application. Such a report must be approved by a qualified professional to the satisfaction of the Council Engineering Department. Land use changes involving loading, excavation or changes to drainage may affect the stability of the site and/or adjacent areas and their consequences should be assessed before work starts. Development will not be permitted unless the Council is fully satisfied that the necessary engineering works will be carried out including arrangements for their subsequent maintenance.
Zone 5	Slope instability problems are almost certainly present and may be active. Allocation of land-use in this zone must reflect the guidance given in PPG 14 that the council be satisfied that developments in such areas are designed with an adequate appreciation of the ground-stability issues and take into account relevant factors at the design stage. The Council will require the submission of a detailed ground investigation report, specifically considering slope instability of the site and adjacent land as part of any planning application. Such a report must be approved by a qualified professional to the satisfaction of the Council Engineering Department. Remediation and/or mitigation works may be necessary to stabilize the area prior to construction. Construction may not be economically feasible. Development will not be permitted unless the Council is fully satisfied that the necessary engineering works will be carried out including arrangements for their subsequent maintenance. Land within this zone has been classified as an area in which slope instability problems are almost certainly present and may be active.

Feedback

The landslip module was implemented for Telford and Wrekin Borough as a strategic planning tool. The Chief Engineer was invited to comment: his verbal feedback suggested that the approach used in this module was adequate to provide an effective assessment of susceptibility to landslip.

Soluble rocks (dissolution)

Scope and planning context

All carbonate rocks (limestone, dolomite, chalk) are prone to dissolution by natural groundwaters, as are evaporite minerals such as gypsum and rock salt. Solution leads to the development of an often interconnecting network of caves, microcaves and enlarged fissures and the occurrence on the surface of closed depressions known as sinkholes or dolines. These underlie about one fifth of England parts of South and North Wales and small parts of Scotland. Houses and roads can collapse and the problem can be aggravated by flooding, extreme rainfall events and badly designed drainage.

Planning Policy Guidance 14 (Department of the Environment, 1996) looks at the problems caused by soluble rocks and provides advice to local authorities on dealing with this issue. The guidance advises:

- identifying areas where dissolution of soluble rocks is taking place or that are susceptible to dissolution of soluble rocks
- controlling or restricting development within these areas
- setting a local policy that identifies the criteria and information requirements for determining applications in soluble rocks areas

Data and models

The soluble rocks module within the EISP addresses the national problem of identifying areas susceptible to dissolution of soluble rocks.

In the past hazard assessment has often been based on a probabilistic approach using the premise that if there have been dissolution of soluble rocks in an area in the past then there will be many in the future. However, with the prospect of climate change and the fact that human activity and demands on the environment change through time, past events are not necessarily a good guide to future problems.

The EISP dissolution of soluble rocks susceptibility module employs a more fundamental method and uses a deterministic approach that looks at factors, such as lithology and presence and levels of groundwater, that increase a site's susceptibility to soluble rock dissolution activity. The causative factors that are present are assessed according to their relative importance in promoting dissolution of soluble rocks and combined in a GIS to give a plot of the relative degree of susceptibility to the dissolution of soluble rocks activity across the area. A high rating does not necessarily mean that the dissolution of soluble rocks are present, have happened in the past or will do so in the future but if conditions change through natural or artificial means and factors are added or intensify, then dissolution of soluble rocks may be triggered.

The methodology used to create this assessment does not indicate the current instability at a site. It indicates the potential for such a hazard to be present and thus the relative importance of obtaining additional information when changes in land use are proposed. The additional information may require a site-specific assessment of the hazard or an investigation of the surrounding area to assess its impact on the proposed change or vice versa. Assessment may require some or all of the following:

- a desk study
- site visit

- sampling and geotechnical testing of the materials beneath the site and/or its surroundings

The output from the module is expressed in terms of five Geosure susceptibility zones similar to the landslide susceptibility zones in table 6.2.

Shrink-swell clays

Scope and planning context

Some rocks that contain clays can increase or decrease in volume as they absorb or lose water. These volume changes can cause, either swelling (heave) or shrinking (subsidence) and cause damage to foundations of infrastructure and buildings. The potential of swelling and shrinking clay is moderate across the UK but areas of southern and eastern England are particularly at risk.

Planning Policy Guidance 14 (Department of the Environment, 1996) looks at the problems caused by of swelling and shrinking clays and provides advice to local authorities on dealing with this issue. The guidance advises:

- identifying areas that are susceptible to swelling and shrinking clays.
- controlling or restricting development within these areas
- setting a local policy that identifies the criteria and information requirements for determining applications in areas where swelling and shrinking clays are present

Data and models

The shrink-swell module within the EISP addresses the national problem of identifying areas susceptible to shrinking and swelling clays.

In the past hazard assessment has often been based on a probabilistic approach using the premise that if there have problems from shrinking and swelling clays in an area in the past then there will be many in the future. However, with the prospect of climate change and the fact that human activity and demands on the environment change through time, past events are not necessarily a good guide to future problems.

The EISP shrinking and swelling clay susceptibility module employs a more fundamental method and uses a deterministic approach that looks at the presence of factors, such as the lithology and plasticity values, that increase a site's susceptibility to shrinking and swelling clay susceptibility. The causative factors that are present are assessed according to their relative importance in promoting shrinking and swelling and combined in a GIS to give a plot of the relative degree of susceptibility to shrinking and swelling activity across the area.

The methodology used to create this assessment does not indicate the current instability at a site. It indicates the potential for such a hazard to be present and thus the relative importance of obtaining additional information when changes in land use are proposed. The additional information may require a site-specific assessment of the hazard or an investigation of the surrounding area to assess its impact on the proposed change or vice versa. Assessment may require some or all of the following:

- a desk study
- site visit
- sampling and geotechnical testing of the materials beneath the site and/or its surroundings

The output from the module is expressed in the same terms as the Soluble rocks Geosure susceptibility zones.

Compressible & collapsible deposits

Scope and planning context

Some types of soils and rocks may contain layers of very soft materials like peat or some clays. These may compress or collapse if unevenly loaded by overlying structures, or if the groundwater levels changes.

Planning Policy Guidance 14 (Department of the Environment, 1996) looks at the problems caused by compressible and collapsible soils and provides advice to local authorities on dealing with this issue. The guidance advises:

- identifying areas that are susceptible to compressible and collapsible soils.
- controlling or restricting development within these areas
- setting a local policy that identifies the criteria and information requirements for determining applications in compressible and collapsible soil areas

Data and models

The compressible and collapsible modules within the EISP addresses the national problem of identifying areas susceptible to compressible and collapsible soils.

In the past hazard assessment has often been based on a probabilistic approach using the premise that if there have been many compressible and collapsible soils collapses in an area in the past then there will be many in the future. However, with the prospect of climate change and the fact that human activity and demands on the environment change through time, past events are not necessarily a good guide to future problems.

The EISP compressible and collapsible soils susceptibility module employs a more fundamental method and uses a deterministic approach that looks at the presence of factors, such lithology and occurrence and levels of groundwater, that increase a site's susceptibility to compressible and collapsible soil collapses. The causative factors that are present are assessed according to their relative importance in promoting compressible and collapsible soil collapses and combined in a GIS to give a plot of the relative degree of susceptibility to compressible and collapsible soil across the area. A high rating does not necessarily mean that compressible and collapsible soils are present, have happened in the past or will do so in the future but if conditions change through natural or artificial means and factors are added or intensify, then slope instability may be triggered.

The methodology used to create this assessment does not indicate the current instability at a site. It indicates the potential for such a hazard to be present and thus the relative importance of obtaining additional information when changes in land use are proposed. The additional information may require a site-specific assessment of the hazard or an investigation of the surrounding area to assess its impact on the proposed change or vice versa. Assessment may require some or all of the following:

- a desk study
- site visit
- sampling and geotechnical testing of the materials beneath the site and/or its surroundings

The output from the module is expresses in the same terms as the Soluble rocks Geosure susceptibility zones.

Running sand

Scope and planning context

Running sands occur when loosely packed sand becomes fluidised by water flowing through the spaces between the grains. The pressure of the flowing water reduces the contact between the grains and they are swept along in the flow. Running sand is most prevalent in the middle and south of England.

Planning Policy Guidance 14 (Department of the Environment, 1996) looks at the problems caused by running sand and provides advice to local authorities on dealing with this issue. The guidance advises:

- identifying areas that are susceptible to running sand problems
- controlling or restricting development within these areas
- setting a local policy that identifies the criteria and information requirements for determining applications in running sand areas

Data and models

The running sand module within the EISP addresses the national problem of identifying areas susceptible to running sand problems.

In the past hazard assessment has often been based on a probabilistic approach using the premise that if there have been many running sand problems in an area in the past then there will be many in the future. However, with the prospect of climate change and the fact that human activity and demands on the environment change through time, past events are not necessarily a good guide to future problems.

The EISP running sand susceptibility module employs a more fundamental method and uses a deterministic approach that looks at the presence of factors, such as such lithology and occurrence and levels of groundwater, that increase a site's susceptibility to running sand problems. The causative factors that are present are assessed according to their relative importance in promoting running sand instabilities and combined in a GIS to give a plot of the relative degree of susceptibility to running sand activity across the area. A high rating does not necessarily mean that running sand events are present, have happened in the past or will do so in the future but if conditions change through natural or artificial means and factors are added or intensify, then slope instability may be triggered.

The methodology used to create this assessment does not indicate the current instability at a site. It indicates the potential for such a hazard to be present and thus the relative importance of obtaining additional information when changes in land use are proposed. The additional information may require a site-specific assessment of the hazard or an investigation of the surrounding area to assess its impact on the proposed change or vice versa. Assessment may require some or all of the following:

- a desk study
- site visit
- sampling and geotechnical testing of the materials beneath the site and/or its surroundings

The output from the module is expresses in the same terms as the Soluble rocks Geosure susceptibility zones.

6.4 Hydrogeology and hydrology

The EISP contains three modules which relate to surface and ground waters. Flood risks, the capacity of local drainage systems and quality of groundwater resources are all affected by urban development. New developments need to take into account potential impacts both upon surface waters and on groundwater storage, flows and quality. These impacts can be local or catchment wide.

Groundwater in the UK is generally of good quality, and in England contributes about 33 per cent of public drinking water supply. In recent years, an increasing number of cases of deterioration have been reported due to a variety of causes, including poorly located waste disposal sites, modern agricultural practices and overpumping of resources. One of the major sources of pollutants is perceived to be from chlorinated solvents and hydrocarbons, which are difficult to remediate using traditional methods.

On a national scale, as stated in recent government planning guidance, damage from flooding is greater than that from any other natural disaster. Approximately 10,000 km^2 (8% of the land area of England) is at risk from fluvial and tidal river flooding. Flooding can endanger lives and damage property. Recent insurance industry figures also illustrate the significance of another important source of flooding problems. Approximately half of all flood damage is caused by local drainage incapacity rather than inundation from main rivers 'breaking' their banks.

The three modules, groundwater, flood risk and drainage, are described below.

6.4.1 Groundwater protection module

Scope and planning context

Groundwater regulation is governed by national legislation and increasingly by successive Directives issued by the European Community (Table 6.3). These are aimed at maintaining and improving both surface waters and groundwater by managing river basins in an integrated manner.

Groundwater protection is regulated in England and Wales by the Environment Agency (EA) and in Scotland by the Scottish Environment and Protection Agency (SEPA).

Local authority responsibilities are set out in 'Policy and Practice for the Protection of Groundwater' (EA, 1998). This publication sets out six main threats to groundwater:

- physical disturbance of aquifers and groundwater flow
- waste disposal
- contaminated land
- disposal of liquid effluents and slurries
- underground discharges
- diffuse pollution of groundwater

Table 6.3 Groundwater national legislation and EU Directives

Legislation	Purpose
Water Resources Act 1991	Includes references to monitor and protect the quality of groundwater (Section 84) and to conserve its use for water resources (Section 19)
Groundwater Regulations 1998	Controls discharges of List 1 and List II substances to groundwater
Water Framework Directive (2000/60/EC)	Aims to improve the aquatic environment
Groundwater Directive (80/68/EEC)	Protection of groundwater against pollution caused by dangerous specified substances

Data and models utilized

The Groundwater Protection Policy promoted by the Environment Agency uses a two-tier approach, protecting the overall groundwater resource by means of *Groundwater Vulnerability Maps* and protecting individual groundwater sources by means of *Source Protection Zones*. These provide a framework for decision-making but are not prescriptive and need to be qualified by site-specific considerations.

Groundwater vulnerability maps covering England and Wales identify areas vulnerable to groundwater pollution. The assessment is based on an estimation of the attenuating characteristics of the soil, the distribution of major and minor aquifers in the subsurface and the hydro-geological characteristics of strata in the unsaturated zone. The first generation of these maps was published in the late 1990s and is available digitally. The maps have been criticised for their small scale (1:100 000), which makes them less appropriate for site assessment, and for the lack of account taken of superficial deposits. More recent local studies are addressing these issues and leading to the development of more refined maps for some areas.

Source protection zones are designated to protect public water supply abstractions by defining zones within which groundwater is at greatest risk from certain polluting activities. They are defined by the EA as follows:

Zone 1 (Inner Source Protection Zone) is designed to protect against the effects of human activities which might have an immediate effect upon the source. It is defined specifically by a 50-day travel time from any point below the water table to the source, and additionally a minimum 50 m radius from the source.

Zone II (Outer Source Protection Zone) is defined by a 400-day travel time or 25 per cent of the source catchment area, which ever is larger.

Zone 3 (Total catchment) Defined as the total area needed to support the abstraction or discharge from the protected groundwater source.

The shape and size of the zones is controlled by natural ground (hydrogeological) conditions and other factors including the operation of the groundwater abstraction.

In implementing the groundwater protection module in the EISP, decision flows have been constructed following the guidelines set out ‘Policy and Practice for the Protection of Groundwater’. A cut-down version of the full logical flow was implemented for the London Borough of Newham, using aquifer vulnerability and source protection zone data supplied by the Environment Agency.

Feedback

No one from Newham was actually available to test this module. However, after demonstration of the module the Strategic Planner for the local authority suggested that although this flow was complex (it is actually the decision flow with most steps, more than 100) the system actually processed the material very quickly. He stated that this topic is usually referred to the Environment Agency, but that actually the local Environment Agency Office had a lack of available skill and local knowledge in this area. He was also pleased that the necessary detail (e.g. cemeteries), was included in the flow, raising the profile of issues that should be checked within the planning system.

6.4.2 Flood risk module

Scope and planning context

Local planning authorities have a responsibility to ensure that flood risk is properly accounted for in the planning process. In England and Wales, the assessment of flood risk is based upon recommendations which are sought and received by local authority planners from the Environment Agency.

Relevant legislation includes the Town and Country Planning Act 1990, Building Regulations 1991, Land Drainage Act 1994, Water Resources Act 1991, Environment Protection Act 1990, Environment Act 1995. The national policy for flood defence is determined by DEFRA in England. The latest planning guidance is laid out in PPG25 (table 2.1). This confirms that the Environment Agency has the lead role in providing advice on flood issues, both at a strategic level and in relation to planning applications. As well as being a statutory consultee for certain classes of planning application (PPG25, paragraph D10), the Environment Agency issues guidance (in its “Liaison with local planning authorities” publication) on other types of applications on which it wishes to be consulted. The management of flood risk therefore depends upon partnership between the EA and local planning authorities. PPG25, paragraphs 60 and 72 states that developers are responsible for (a) providing an assessment (by a suitably qualified competent person) of the flood risk caused by the development and (b) satisfying the local authority that the site can be developed and occupied safely. Guidance on this Flood Risk Assessment process is published as

PPG25 Appendix F. Local planning authorities are not required to carry out their own assessment, but may rely on the developer’s information, subject to any views expressed by consultees.

There are also devolved powers in Wales and Scotland. The National Assembly of Wales has a statutory obligation towards sustainable flood risk management, whilst in Scotland there is a less centralised approach involving the Scottish Executive Environment and Rural Affairs Dept, 32 Local Authorities, riparian landowners and SEPA. Flood risk assessment follows procedures laid out in (NPPG7) with SEPA as a statutory consultee.

The importance of flood issues within the planning process was reinforced by major flooding events during Easter 1998 and winter 2000/2001. The EISP therefore includes a module that is designed to support the assessment of the potential impact of proposed developments on the overall level of flood risk within the planning authority. The EISP flood risk component has been designed to ensure that it is consistent with complementary national information systems such as the Environment Agency Property Search system. Efforts have been and are being made, through consultation with the Environment Agency to ensure that the module is fully in line with Agency practice.

Concepts and models

In assessing the overall flood risk, consideration must be given to the level of risk faced by the development itself, as a consequence of its proposed location, and also to potential changes in the frequency and impacts of flood events at local or broader catchment scales that might result from hydrological changes brought about by the development. Examples of less desirable impacts could include (1) loss of capacity for flood storage on floodplains due to diversions or embankments, or (2) increased downstream flood flows due to an extension of impermeable surfaces coupled with a traditional engineered drainage system. The flood module addresses (1) by covering risk to the site from its location with respect to existing floodplain areas. Issues of local drainage (2) are covered by a separate flow (drainage).

For the floodplain component, PPG25 includes a “sequential approach”, giving guidance on the types of development that can be allowed in different risk areas. This sequential approach has been incorporated in the EISP. However, the spatial data sets needed in this approach to delimit the different risk areas are not yet fully available; interim data sets were therefore provided to allow this module of the EISP to be implemented within the selected test areas.

As mentioned above, the flood risk module of the EISP was designed to represent the current approach to the assessment of flood risk following discussions with Environment Agency officers. For the purposes of the pilot study, existing flood outlines and estimates of risk derived from datasets developed and held by CEH were utilised. As the system moves towards operational status, it will become necessary to incorporate maps of current flood risk, carrying the approval of the Environment Agency.

Data and models utilized

The Flood Risk module requires spatial databases that define: (1) the Indicative Floodplain; (2) the Extreme Flood Outline; (3) the Functional Floodplain; and (4) undeveloped areas. The source of flood risk data used in this pilot version of the EISP includes the CEH flood risk maps (Morris & Flavin, 1996), and the EA Indicative Floodplain (IF) maps supplied to LPAs. (see also the ‘my backyard’ zone of EA website at http://www.environment-agency.gov.uk). The CEH maps, based on digital terrain data and a simple flood depth model, depict the estimated 100-year return period flood extent in the absence of any flood defences. The Indicative Floodplain maps (1) are based on the CEH maps, but incorporate any historic flood data and results from more detailed model studies. Extreme Flood Outlines (2) are currently being developed by the EA to represent the 1000-year flood extent; until they are available, this pilot version uses a 100 metre buffer drawn around the IF boundary. The Functional Floodplain (3) is defined in PPG25 as the actual area of floodplain where water regularly flows in times of flood (regularly is undefined but may be taken as more than once every ten years). This area should be defined in the local structure plan, but this pilot version uses the area on the CEH maps where flood depth exceeds 2m. The undeveloped area (4) should also be defined in the local structure plan, but this pilot version uses the non-urban area shown on the CEH Land Cover 2000 database.

The Flood Risk module also requires the location of any existing flood defences, and the level of protection those defences offer.No formal model is used in this module.

The example (Figure 6.3) shows the results of using the EIS to assess flood risk associated with a hypothetical proposed development on undeveloped land within the Functional Floodplain.

Feedback

The Flood risk module was implemented for Newham and Telford and Wrekin local authorities. It is compliant with both the groundwater and land contamination modules, following Environmental Agency guidance. However, the team was able to supply enhanced datasets to populate the module, compared with those currently used by the EA. Newham local authority did not test this module, but on demonstration suggested that it would be useful to include Flood Risk at the strategic level of planning in future.

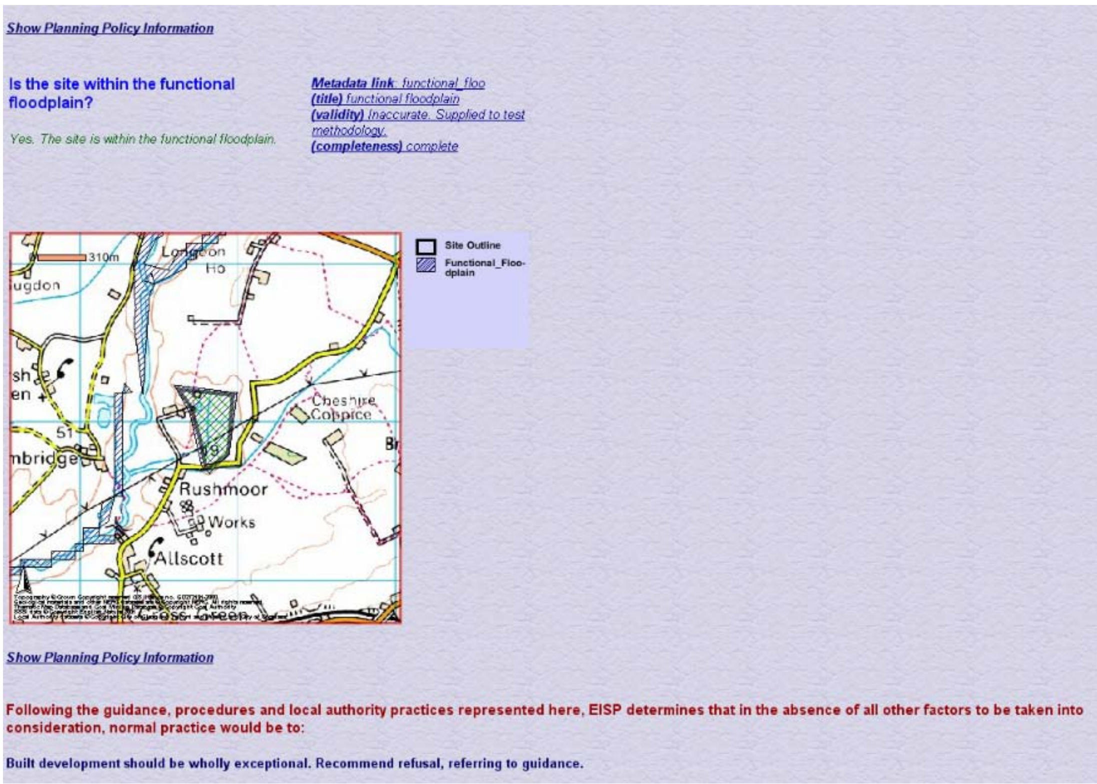


Figure 6.3: Proposed development on undeveloped land and within the Functional Floodplain

6.4.3 Drainage module

Scope and planning context

Ensuring adequate local drainage for both foul (domestic wastewater) and surface (rainwater) runoff has long been recognised as a planning issue, and all but the simplest of planning applications will have to provide outline details of how such drainage will be accomplished.

Subject to a standard charging formula, developers have the right to connect to public foul and surface water sewers (where they exist), or to requisition a new branch into the sewer (if necessary). In large developments, new lateral sewers connecting individual properties to the main sewer may be built by the developers but subsequently adopted and maintained as public sewers by the local sewerage undertaker. In more remote areas, foul drainage may be to an on-site septic tank (providing basic treatment with effluent disposal by soakage into the soil). Surface runoff may also be to soakaway or direct to local watercourses. In both cases, discharge authorisations may be required from the Environment Agency. While connection to public sewers is preferred for foul drainage, greater use of soakaways and other on-site procedures is being encouraged in order to reduce the volume and rate of runoff to downstream pipes and watercourse. The aim is to limit both the increase in flood risk and the washoff of pollutants caused by the development. The result is to provide sustainable (urban) drainage systems (or SuDS) that minimise damage to the downstream environment (see PPG25, CIRIA, 2001, EA, 2003).

Local planning authorities are responsible for ensuring that drainage is properly provided for via the planning process. Relevant legislation includes the Town and Country Planning Act 1990, Building Regulations 1991, Land Drainage Act 1994, Water Resources Act 1991, Environment Protection Act 1990, Environment Act 1995 (similar powers exist for Wales and Scotland). However, effective drainage provision depends upon partnership between the local planning authorities, the developers, the sewerage undertakers and the EA (SEPA in Scotland). The Environment Agency has a crucial role in providing advice on drainage, at a strategic level and in relation to planning applications. As well as being a statutory consultee for certain classes of planning application, it issues guidance (in “Liaison with local planning authorities”) on the types of applications on which it wishes to be consulted. It negotiates with developers over allowable rates of discharge to the downstream environment, and will audit developers discharge calculations.

The role of the local planning authority is mainly to encourage and co-ordinate the overall approach to drainage, rather than the detailed checking of developers’ designs. The drainage module included in the EISP reflects that role by providing layered text-based guidance on drainage considerations. Efforts have been made to ensure that this module is in line with current EA advice.

Concepts and structure

Development may not only itself be at risk of flooding, but could increase downstream flood flows by linking increased impermeable surfaces to an efficient engineered drainage system. The flood module covers the risk to the site from its location with respect to existing floodplain areas, while the drainage module covers provisions for draining local flood runoff from the site and in particular the use of Sustainable Urban Drainage Systems (SUDS).

Drainage from new development has traditionally used pipes of sufficient capacity to convey all runoff rapidly from the site. Design is straightforward, and systems are usually adopted and managed by the local sewage authority. However, such systems can increase flood risk downstream, and new ‘Sustainable’ approaches (SUDS), incorporating combinations of structures such as soakaways, swales and retention ponds to reduce and slow water movement, are strongly advocated in PPG25 (paragraph 40-2 and Appendix E). However, the SUDS approach is still being developed, design is more uncertain, and issues of ownership and maintenance need to be addressed. An Environment Agency Framework document on SUDS, including suggested maintenance templates, was out for consultation in July 2003. Detailed SUDS design is mainly between the developer and the Environment Agency, and the

EISP drainage component is predominantly a checklist on the issues. However, a simple conceptual model to estimate the likely impacts of development upon run off is being developed for future inclusion.

Many of the issues around SUDS are concerned with legal ownership and maintenance, codes of practice and building regulations. There is also much uncertainty over how SUDS should be designed or, more specifically, what the design criteria should be. Most importantly, all the guidance stresses the need for collaboration between planners, developers, the EA, and their various drainage professionals at the earliest opportunity.

Many of these issues are not amenable to presentation in a GIS, or are too detailed for planning purposes (but not for the various drainage professionals who must perform the drainage design). For this reason, the drainage flow provides a simple question and answer format with an introduction to the issues, backed up by linked documents giving more detailed information taken from the relevant codes and guides. If yet more detailed guidance is necessary, EISP users should refer to the full codes, though the summaries should help with finding the relevant parts.

While the main drainage concern is for surface water, foul drainage is also included in the flow, both for completeness and to clarify some of the issues involved.

Data and models used

The drainage component is a text-based flow, presenting the issues that should be addressed. The data comprise outline summaries of various SUDS design documents which can be accessed from the flow. No model is currently used, though a simple method to estimate pre-development runoff rates is discussed and is described in one of the summary documents. This method together with the relevant spatial database of soil type could be developed for future inclusion in the flow.

Note in particular:

SUDframe summarises the SUDS framework document released for discussion in May 2003 by a cross-sectoral Working Party (chaired by the EA). It presents a draft set of criteria for SUDS, and presents detailed guidance on the issues that need to be addressed.

CIRIASUD summarises the CIRIA design manual for SUDS in England and Wales. The manual describes general design principles, but is not a complete manual. The SUDS framework goes further and is generally more informative on legal and management issues. Neither document describes the full technical design methods.

HRDevSites is just a brief review of a relatively full design guide. It describes a logical, staged design approach and provides some technical design guidance.

Soakaway gives some technical guidance on soakaway designs (which planners may need to check).

QuickFEH describes a quick way of assessing pre-development runoff - a major issue in SUDS design.

Feedback

The Drainage module, which comprises the latest guidance on drainage and SUDS is implemented for all authorities in England and Wales, i.e. Newham, Telford and Wrekin, Wolverhampton and Swansea. It is different to the other decision flows as no GIS data are interrogated, and the planner is merely presented with a procedural checklist of questions. The flow was demonstrated to Newham, but we have received no feedback from the other authorities on the content of the flows. The only comment from Newham was that much local data, not held by the EA, could be incorporated within the flow in a production version of the EISP.

6.5 Land contamination

The industrial heritage of the British Isles has left a legacy in many areas of dereliction and pollution. Over 150 years of mineral extraction, manufacturing, chemical and fuel production, metal production and engineering have generated a cocktail of waste products, many of which have been originally deposited on the surface of the ground and allowed to leach into the subsurface (others such as Chromium, may have been placed underground as landfill). Legislation to control industrial processes and resultant pollution and waste disposal has only really been introduced in the last 20 years. Therefore, new build and re-development projects must consider the historical use of the land in order to ensure that the development is not vulnerable to any known or suspected risk from previous pollutants within the ground that could present a threat to organisms, waters or new structures which may be associated with the development.

Other planning concerns relating to land contamination are associated with landfill; the main issue relates to risks resulting from the emission of hazardous gases (mainly methane and carbon dioxide) resulting from bio-degradation of waste disposal products. The planning requirement is to identify situations where there is the possibility of risk and to ensure that specialist assessment is carried out to mitigate them.

6.5.1 Land contamination module

Scope and Planning Context

Land Contamination is regulated by a number of statutory instruments, including the Environmental Protection Act 1990, Water Regulations 1991 and the Environment Act 1995. The primary objectives are to protect humans, controlled waters, ecosystems and property from the effects of pollution that has led to contamination of the ground, subsurface and surface/ground waters. A key concept is that of a 'significant pollutant linkage'. Essentially, this is the presence of a source - pathway - receptor linkage that presents an unacceptable risk to a specified receptor. Risk is evaluated using generic assessment criteria, such as the Soil Guideline Values and/or site-specific assessment criteria.

Development controls dealing with land contamination can be found in every local plan, but are usually the responsibility of the Contaminated Land Officer; therefore, in most authorities, planners will refer issues of Land Contamination to the Contaminated Land Officer. However, the planner has a duty to ensure that any remediation proposed for identified contaminants is sufficient to protect possible receptors. Therefore, it must be possible to check any conceptual site model or reports presented with the development proposal for possible pollutant linkages.

PPG23 and PPG26 (currently available in draft for consultation) and equivalent planning policy documents in Scotland (Pan 33) and Wales (Planning Policy Wales), form the basis for the Land Contamination module within the EISP. This module identifies the presence of any potential pollutant linkages within or adjacent to a proposed development site. As pathways are likely to be site-specific, the planner must determine if sources and receptors actually coincide. If they do, a risk assessment of any potential significant pollutant linkages should be requested. This should identify the main sources and receptors and form a basis against which to assess reports submitted by developers.

EISP does not seek to characterise specific contaminants present on a site, since this can only be achieved with certainty by means of a site investigation. However, by reference to key documentation (DEFRA and EA, 2002) the module suggests which contaminants might be present on the basis of previous land use (DOE, 1996).

This flow does not attempt to assess the risk presented by such linkages, as this requires skills normally supplied by specialist environmental consultants; instead, the outputs take the form of advice about circumstances that may be relevant to the application and where risk assessment advice should be sought. Neither does the module address pathways (as these are generally site specific) or evaluation of proposed monitoring techniques (this was omitted from the proof-of-concept demonstrator, due to constraints on available programming effort).

Concepts and structure

The overall conceptual structure for the Land Contamination module is summarised in Figure 6.4, which also identifies those elements which have been implemented at the proof-of-concept stage (Alker et al., 2003). During the pre-planning process, the assessment focuses on determination of the presence of contamination sources. If any of the primary constraints in Figure 6.4 is triggered, then Land Contamination is identified as a potential issue for the proposed development. Further processing of the full development proposal will diagnose the particular circumstances that led to this situation.

The complete Land Contamination module consists of a number of sub-modules that deal separately with determination of Sources and Receptors (See Figure 6.4). Separate sub-modules have been implemented to assess possible impacts on the different receptors – humans, buildings, ecosystems, agriculture, surface water and groundwater. Processing is sequential. The location and type of contamination is identified first; each of the receptor modules is then processed in turn, using a look-up table to identify, for each possible contaminant, the potential pollutant linkages. For practical purposes the system assumes that people will always need to be considered.

Data and Models used

The Source Determination Module combines digital information on historical land uses, known contamination, contaminated sites under Part IIA and natural contamination, with the Industry Profiles list (DoE, 1996), and Tables 2.3 and 2.4 from DEFRA and Environment Agency 2002. The system reports a list of possible contaminants for each source; in this context, a 'source' is an area of land, delimited by the operator as a polygon overlay on a topographic map. The resultant list is indicative only. Once receptors have been identified, the list of contaminants is refined by reference to Tables 2.1 and 2.2 in the DEFRA / Environment Agency document. The system reports those contaminants related to specific receptors that must be checked to determine whether a risk assessment is necessary. Note that this list is not exhaustive, as it has been derived from a single set of guidelines. Nevertheless, it demonstrates the potential for a fuller set of contaminants to be incorporated in an operational version of the system.

In the case of Newham, 14 datasets were needed to identify sensitive receptors. As data for contaminated sites in Newham is presently unavailable, for the purposes of demonstrating the EISP Land Contamination module, simulated data were generated.

Feedback

The Land Contamination module was implemented for and demonstrated to Newham Local Authority. The main comment from the Environmental Health officer was that it provided comprehensive information on possible pollutant linkages (subject to the quality of the underlying data) but that the information provided was perhaps too detailed for the average planning officer to understand. This module should perhaps be seen more as a tool for the specialist technician or environmental consultant than for direct use by the planner.

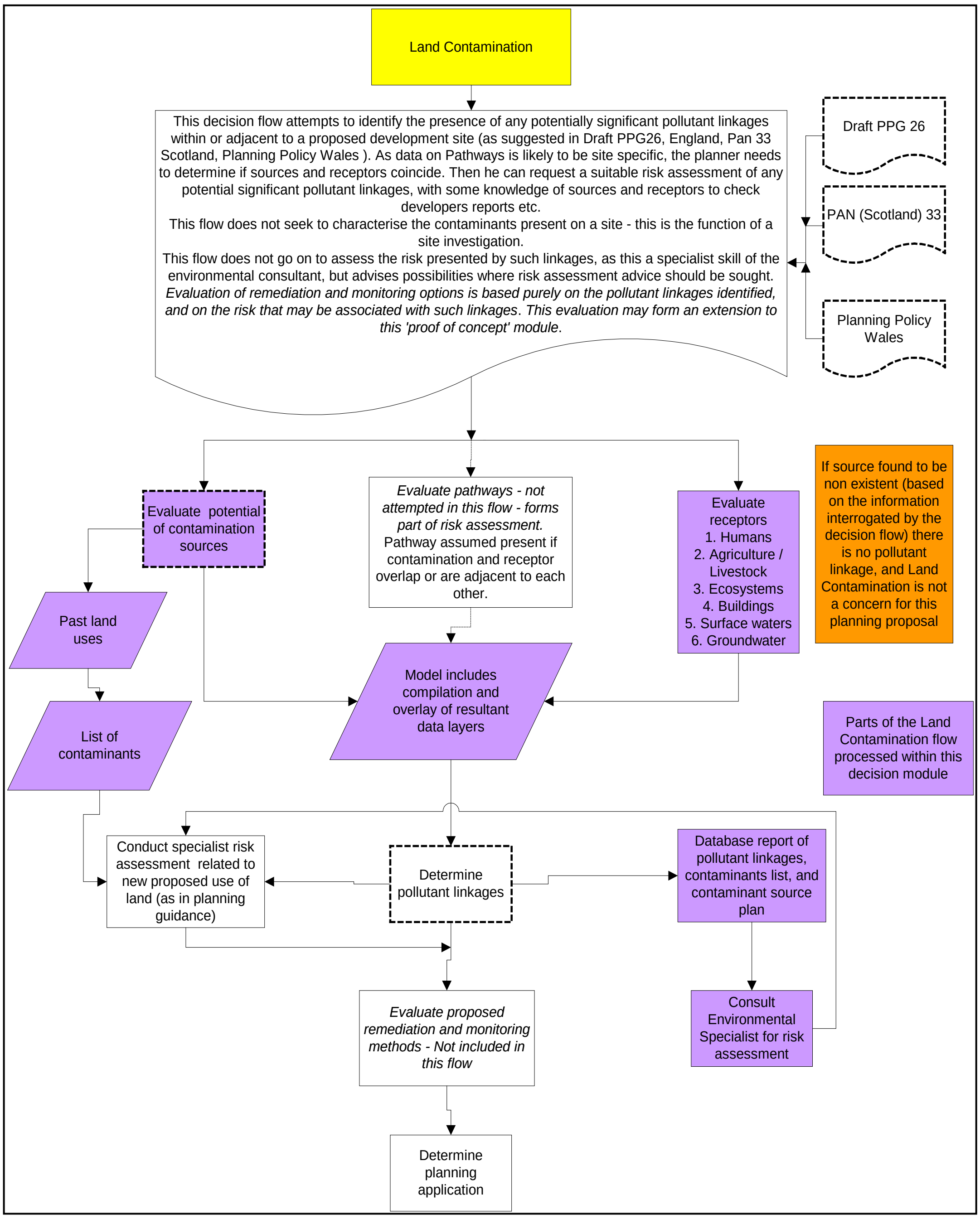


Figure 6.4 Structure of the Land Contamination Module

6.5.2 Proximity to landfill module

Scope and Planning Context

Development near landfill sites in the UK is subject to strict legislative controls. The Environment Agency is currently developing policy for development on or near gassing landfill sites. The level of concern results from past incidents, where buildings have exploded due to the build up of methane within foundation structures and when personnel in service conduits have been subjected to risk of asphyxiation due to high levels of carbon dioxide (HMSO, 1991). Landfill gas is produced from the breakdown of biodegradable wastes predominantly under anaerobic conditions inside a landfill. Methane and carbon dioxide are the main constituents. Landfill gas can easily accumulate in enclosed spaces to flammable (methane) or asphyxiation (carbon dioxide) levels.

Where development is proposed or occurs within 250 m of the boundary of a landfill site, specialist advice should be sought as to the measures that are required to ensure the safety of such development. Within the EISP, a 250 m boundary around the landfill site is used as a primary constraint to inform pre-planning enquiries of potential problems. A buffer of 250 m is set around a digitised representation of the site and the resulting polygon is overlain on a corresponding digital map of landfill (See Figure 6.5).

Concepts and structure

The EISP module covering proximity to landfill is structured to allow proposed developments to be assessed against limits specified in legislation and local planning policies. The assessment considers the proximity of the development to landfill, whether the landfill site is gassing, and the type of development proposed (residential, commercial, industrial, retail, open space and gardens) and whether the proposal relates to a new development or an extension to existing developments.

The system advises of relevant local planning conditions and informatives for a range of types of development proposals, along with a recommendation to accept or refuse planning permission, depending on the circumstances of the application.

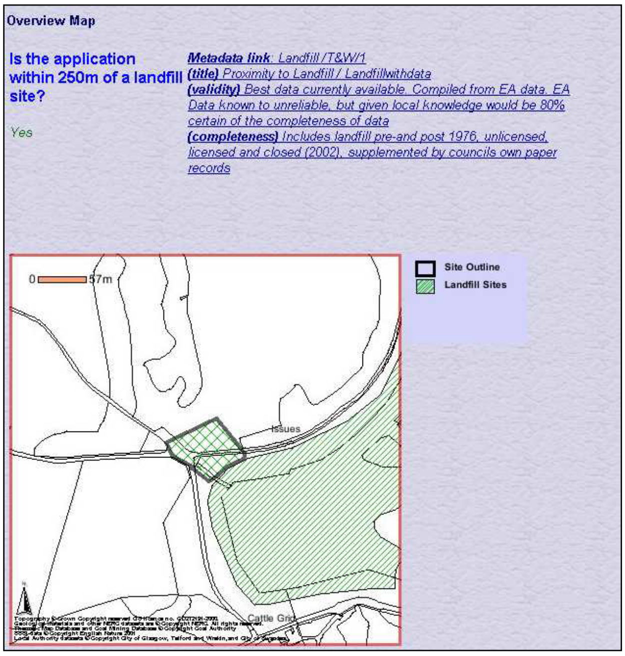


Figure 6.5 Proximity to Landfill (pre-Planning Enquiry)

Data and Models Used

Only two data sets are used for the above analysis. The first of these is a compilation of records and information from local authorities, Environment Agency (post-1976) and BGS (pre-1976) that delimit areas of landfill and record their status (open / closed, licensed / unlicensed, gassing / non-gassing). From these basic records, a GIS dataset was constructed by applying a 250 m buffer to gassing landfills. The second data set is a synthesis of land use compiled from several GIS layers supplied by the Local Authority (Telford and Wrekin, in the case of the demonstrator). From this dataset, it was possible to identify adjacent land uses that may be put at risk by earthworks etc., at the proposed development.

No specific models are used to manipulate these data sets except the application of GIS functions such as variable buffer widths around features. However, the decision flow does refer the planner to models e.g. GASSIM (Golder Associates and Land Quality Management, 2002) which would be used by an environmental expert for the assessment of risk to developments from landfill gas. In most cases, the planner would simply attach conditions (see Figure 6.6, for example) to any development within 250 m of a landfill as a precautionary measure.

Feedback

Proximity to Landfill was implemented for Telford and Wrekin local authority. In this case the flow mimicked Telford's own procedures and as such was straightforward and acceptable to the Local Authority.

During this research (May 2002) the project team discovered that the Environment Agency were in the process of delegating dealing with the issue of development in proximity to landfills to the local authorities. The draft guidance we have seen indicates that the Proximity to Landfill module already provides an adequate tool for local authorities to deal with this task. In addition, other proximity issues, such as IPPC regulations, could also be modelled in the same way as this module.

Conditions

Condition 45 - No development shall take place until an investigation of the site has been undertaken to ascertain whether the site has been affected by the presence of landfill gas. The investigation shall be undertaken in accordance with a brief which shall be first agreed in writing with the local planning authority. The results of the investigation shall be provided to the Local Planning Authority and shall include a scheme for precautionary measures to ensure that no build up or ingress of gas occurs within the development. The approved scheme shall be implemented in full and written evidence to confirm the completion of work provided to the local planning authority before the development is occupied. To ensure that the development is adequately protected from the migration of gas.

Figure 6.6 Proximity to Landfill – Typical Conditions for Planning Approval

6.6. Urban ecology and landscape

Conservation of the UK's natural capital[1] is an important policy goal, bound up with a large and complex array of international, European and national legislation. Planners have a critical role to play in this process, either by constraining inappropriate or damaging development or actively promoting renewal of degraded habitat. Specific planning guidance exists with respect to environmental issues, in the form of PPG 7 (Countryside) and PPG9 (Nature Conservation). However, these tend to be indicative rather than prescriptive. The guidance with respect to biodiversity and nature conservation is sometimes unclear, with numerous gaps especially relating to non-designated habitat and species.

Within the EISP two separate decision flows are used to cover some of the key environmental issues tied up with this process, namely the Biodiversity Flow and the Natural Heritage Designations Flow.

6.6.1. Biodiversity Module

Scope and Policy Context

Biodiversity covers a range of nature conservation issues relating to both species and habitat. Key pieces of legislation which have been consulted and form a framework for these issues within the EISP include:

- The Countryside and Rights of Way Bill 2000
- Environment Act 1995

[1] *The term 'natural capital' has emerged from the relatively new discipline of ecological economics. One definition offered is that of Berkes & Folkes (1994: 129) which defines natural capital as: non-renewable resources extracted from ecosystems plus renewable resources produced and maintained by ecosystems and environmental services provided by those ecosystems. With respect to this document the term encompasses all those aspects of biodiversity which we value, including the sum total of species and habitats but also less tangible qualities of open space, tranquillity, landscape quality etc.*

- Wildlife and Countryside Act 1968
- National Parks and Access to the Countryside Act 1949
- Hedgerow Regulations 1997
- European Birds Directive (79/409/EEC)
- European Habitats Directive (92/43/EEC)
- PPG2 (Greenbelts), PPG7 (Countryside), PPG9 (Nature Conservation), PPG20 (Coastal Planning).
- Planning Policy for Wales and associated Technical Advice Notes

In addition to these specific pieces of environmental legislation, the UK Biodiversity Action Plan UK BAP) has taken a central role in the development of this decision flow.

The scope of the Biodiversity flow is limited at present to legislation covering England and Wales. Specific reference has not yet been made to any additional requirements imposed by legislation from the Scottish Parliament.

Concepts and structure

All of the core nature conservation issues are dealt with within the Biodiversity flow. Due to the complexity of this topic, this flow covers two key areas, namely habitat and species. The species component has two other subsections covering trees and hedgerows. These four sections are all worked through in turn but to the user the flow is seamless. Within each of the four themes the following key issues are addressed:

HABITAT

- Semi-natural habitat
- Priority habitats including Biodiversity Action Plan priorities and the Local BAP.
- Green wedges / belt
- Landscape protection areas
- Green corridors
- Pocket ecological sites (small areas of local nature conservation interest)
- Brownfield sites.

SPECIES

- Key species protected by legislation under the Wildlife and Countryside Act 1981 (this includes species such as badgers, hares, bats, birds of prey etc.)
- UK BAP species of conservation concern.

TREES

- Any trees on site
- Tree Preservation Orders

HEDGEROWS

- Any hedgerow present
- Hedgerows in open countryside, covered by the Hedgerow Regulations
- UKBAP species in hedgerows.

The habitat part of the system is better underpinned by supporting datasets than the species part. Many local authorities have their own land use and habitat data, available in GIS format. In terms of species protection and the UK BAP, protection of habitat does help to protect many species. However, not all species are confined to land which is likely to be protected through designation. Some (such as bats for example) can make their homes in the unlikeliest places (derelict buildings on brownfield sites for example) and so their particular cases are dealt with separately under the species component of the biodiversity flow. This starts by identifying ‘key species’ which need consideration outside of their associated habitats and clarifying their legal protection.

The tree part of the flow deals with Tree Preservation Orders for which there are well-established procedures within local authorities. However, they can be reactive in nature and valued trees can be lost with the development process. This part of the flow encourages the user to consider all the trees on the site and to encourage protection of native trees where possible.

Hedgerows are dealt with in the final part of the biodiversity flowchart. The hedgerow regulations have defined ‘important hedgerows’ within the open countryside and these criteria were used directly within the system. The same approach was applied to all hedgerows, urban or rural to encourage consideration of the role of urban hedgerows in biodiversity within towns.

The UK Biodiversity Action Plan forms a key part of this flow and has specific reference to the Local Biodiversity Action Plan of Swansea.

Data and Models Used

Datasets for the test local authority (Swansea CC) were used within the prototype system. These datasets were relatively complete and many habitat layers were available as up-to-date GIS datasets. The only dataset which was used to supplement these local datasets was the CEH Land Cover Map 2000 which was used to extract some information about the location of priority habitats within the local authority area.

Notable gaps in data relate to species datasets. Local authorities do not generally hold information about the distribution of priority animal and plant species, which currently resides in many different places. It is therefore frequently necessary to acquire suitable data, often in an *ad hoc* fashion, from external sources, such as Wildlife Trusts, Local Record Centres, National Record Centres or specially commissioned surveys.

This area of South Wales does not as yet have a Local Record Centre and so there is no one repository of species data. Lack of basic information of this sort affects the ability of the local authority to make quick decisions about development. The flowchart frequently requires the user to seek information about species distributions and directs the user to possible sources including the Local Wildlife Trusts, the Countryside Council for Wales and non-governmental organisations such as the RSPB. For this component of the EIS to work more efficiently would require the Local Authority to have digital access to species data. This is already achievable in areas where Local Records Centres exist with appropriate levels of IT. Ultimately, the National Biodiversity Network (www.nbn.org.uk) will deliver much of the necessary functionality nationally across the internet.

No formal models were used within the biodiversity designation flowcharts. There were a number of reasons for this, but the main one was a lack of maturity and development of ecological models for urban areas. Many of the species / habitat type models are relatively noisy (in that explanatory factors often only account for small amounts of variance in the model). None of the ecological work funded through URGENT fitted clearly into the framework of the EISP. The final results of the urban tree planting project could in future be linked in as information about which species to consider when planting trees in urban areas, but the other projects were too far from practical application at the development control end of the planning process.

6.6.2. Natural Heritage Designation

Scope and Policy Context

The natural heritage designation flow (so named to distinguish it from built heritage) covers many key aspects of nature conservation. The following designations are implemented within this flow:

Internat

RAMSARs

SACs and SPAs

Nationa

National Parks & AONBs National Nature Reserves,

Sites of Special Scientific Interest (SSSI), Ancient Woodlands

Local

Local Nature Reserves (LNRs), Historic Parks, Country Parks, Green wedges / belts

Concepts and structure

All of the designated land issues are dealt with within the Natural Heritage Designations flow. This covers international, national and local designations in order of legislative importance and has been tailored to incorporate Swansea's own local designations (such as green wedges, local nature reserves etc). Environmental Impact Assessments are dealt with briefly at the start of this flow.

The decision flow works by identifying all areas of designation present on the site of interest. Many of the decisions within this part of the system can be made automatically, based on spatial searches using the underlying GIS. Each designated area has a "zone of influence" around its border. The size of this zone varies depending on the site but tends to be bigger for internationally important sites (such as RAMSAR wetlands) than local sites and currently ranges from 100 m to 1 km. International and national designations have statutory protection under law, whilst local designations are part of the local authority planning policy guidelines.

Data and Models Used

As with the biodiversity module, natural heritage mainly uses GIS datasets created by the collaborating local authority (in this case Swansea CC). However, many of the designated sites are available in GIS form from English Nature and the Countryside Council for Wales. No models were used within this flow.

Feedback

Both the Biodiversity and Natural Heritage Designation modules were developed for Swansea City Council. Swansea CC has good environmental datasets incorporated within its in-house GIS and draws heavily upon these data during its planning procedures. Over 60% of the local authority area has some kind of nature conservation designation with many areas covered by more than one level (AONBs, RAMSARS, SSSIs etc). As the two flows were developed in parallel this feedback reflects general discussion with the staff with respect to the Biodiversity and the Natural Heritage Designations.

During demonstrations of these two flows to local authority staff in Swansea it became apparent that further development of both elements of the EISP would be required for it to cope fully with the complex issues associated with biodiversity. In particular, the Environmental Impact Assessment module was considered to be very important. Currently the EIA part of the system is quite brief (Is an EIA required or not?) but it was considered to be worthy of total integration within the system. EIA can take up a considerable amount of time and many of the procedures are now well documented and would lend themselves to automation.

A wider debate was encouraged by the local authority staff with regards to the design of the biodiversity flow. They were well aware of the complexity of the process as well as the failures of current planning guidance to deal with the issues in a clear and consistent way and felt that the flow design would benefit from further input from other experts in the field. This was not expressed in a critical way; most were excited by the potential of the biodiversity flow to improve decision making within their local authorities. However, they felt that wider input from other practitioners would provide a more robust final version, and several LA's from Wales are intending to examine this. It is worth noting that planners in Glasgow also found these modules of considerable interest for future use there if implemented in a production version for Glasgow.

6.7 Man-Made Heritage

Scope and Planning Context

The historic built environment is protected by a number of statutory instruments e.g. conservation area status, World Heritage Site status etc., in order to preserve ancient and important historical buildings, architecture and industry. This allows the use of Man-Made Heritage features as an educational, cultural and tourism resource. Where such sites are well managed and accessible this also provides local revenue, particularly in declining industrial areas.

Development controls can be found in every local plan to preserve ancient artefacts and historically significant sites. PPG15 and PPG16, applied in the Telford and Wrekin council area, were used as the basis for the Man-Made Heritage decision flow within the EISP, although we recognise that they are currently under review by the ODPM.

We demonstrated the modular flexibility of the system by creating a sub-module that deals specifically with local planning and management of the Ironbridge Gorge World Heritage Site (Ironbridge Gorge World Heritage Strategy Group, 2001). Although targeted at the particular local conditions here, the module was written in a way that would allow it to be similarly tailored to other World Heritage sites, of which there are currently 22 in the UK. Of course, these system elements could be ignored by any local authority that is not tasked with managing development in comparable areas.

The module also demonstrates other wider heritage issues, including conservation; although these were considered and incorporated in the generic flow, they were not implemented within the proof of concept EISP due to time constraints for programming.

Concepts and Structure

The EISP Man-Made Heritage decision flow actually consists of a number of sub-modules that deal with specific features related to man-made heritage. These include: Is the proposed development in an area that is archaeologically important? Does it affect a listed building? (Figure 6.7). These are processed linearly within the system, i.e. the most sensitive constraints are dealt with first and ideally the six modules are processed before the planner makes his / her decision about the development.

Each sub-module includes one or more primary constraint questions that are interrogated automatically during a pre-planning enquiry. If any of these primary constraints is triggered, then pre-planning processing will flag up man-made heritage as being an issue to be addressed by the developer. Further processing of the full development proposal will diagnose the precise context in which the constraint(s) arise.

As in other modules, the system advises the local plan conditions and informatives for a range of development proposals, along with a recommendation to accept or refuse planning permission. It also contains links to appropriate metadata and reference material.

Data and Models used

Each of the sub-modules within the Man-Made Heritage decision flow uses at least one data-set. These are illustrated and detailed on the table below. All data have been cropped to the boundary of the World Heritage site, and provided as GIS data layers to the project by Telford and Wrekin Council.

Most of the logical flow operates as a linear model; no specific scientific or analytical models are utilised, as many of the decision questions are subjective and rely on the planner’s opinion (e.g. Will the development affect the aesthetic quality of the site?).

Feedback

The Heritage flow was only partially implemented for the Telford and Wrekin World Heritage Site area. Overall the LA Planners were impressed with the flow and stated that they would be using it to review current planning policy within the World Heritage Site Local Plan, to see if any policies are redundant or obsolete, particularly where issues are difficult to judge or a matter of individual opinion.

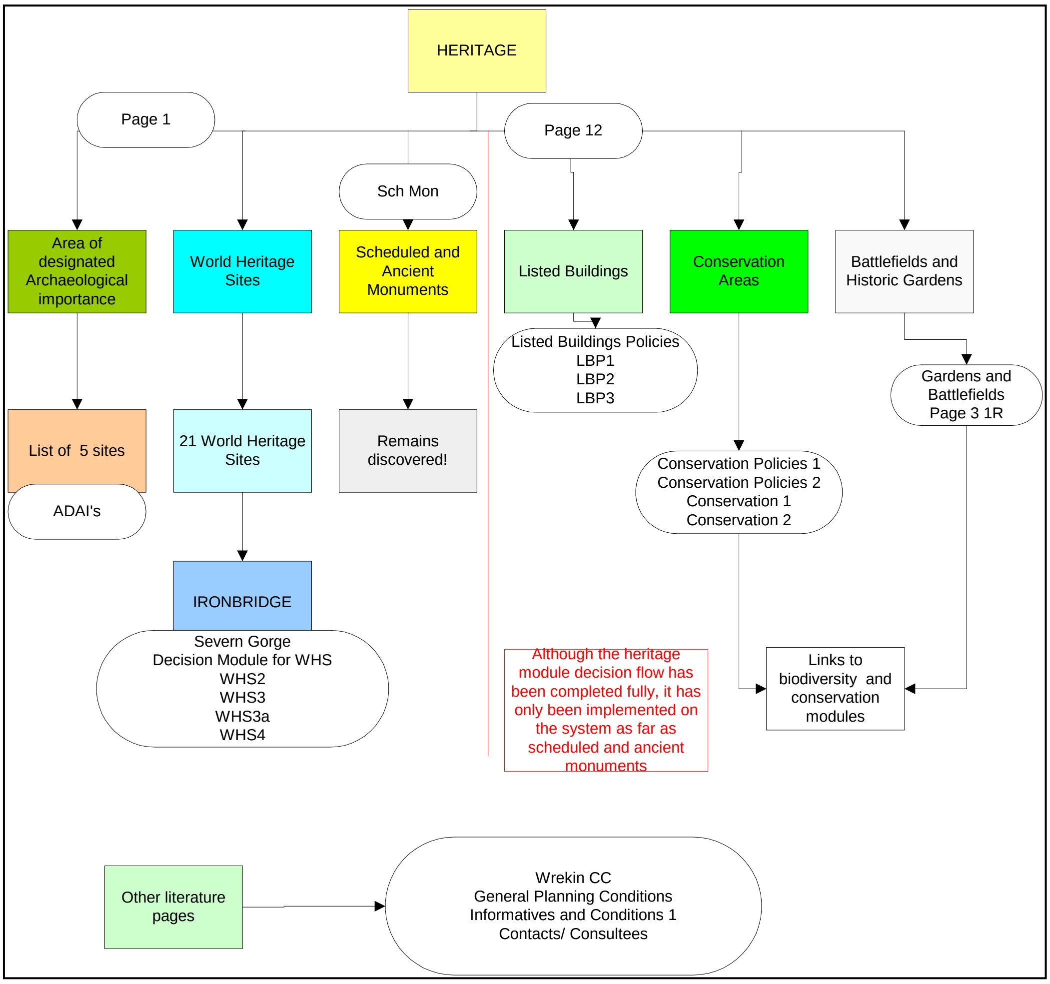


Figure 6.7 Structure of the Man-Made Heritage Module

6.8 Evaluation of overall system design and performance

There are approximately 50 environmental datasets built into the Environmental Information System for Planners. Some of these are unadulterated and as supplied by the data source, others are based on combinations of GIS datasets, whilst others are generated within the EISP as model outputs.

The system comprises 10 Development Control and 2 Strategic Planning modules, underpinned by over 250 pages of logical flow diagrams, which generated over 10,000 lines of programming code.

Although based on official planning guidance, the decision flows are unique and have not previously been available to local authorities. This is the main IPR output of the EISP project. The metadata and literature reference system were also very useful and apparently unique in systems that are available at local authority level.

Overall Need

All authorities recognised the need to check all planning applications and enquiries against environmental considerations, the specialist skills involved and the problems that this presents for the planning process. For example, Newham reported 1500 planning applications per annum involving some environmental judgement.

Pre-application enquiries currently take up a lot of local authority time. The participants found that the ability to check environmental concerns in real time, would actually save a great deal of time – not just in dealing with initial enquiries but also at full application stage.

Design Concepts

All the authorities understood the concept of a decision support tool and appreciated its potential contribution to improving the current decision-making process. All authorities felt that the map excerpts in the final reports were especially useful.

Many of the flows have potential for both development control and strategic planning and many of the responses received were from strategic planners. This potential has not been fully realized in the present implementation, though it was noted that all the flows could be used in a strategic sense simply by submitting multiple land use allocation ‘what if?’ polygons to the system, rather than just a single application or enquiry polygon.

Reporting and Quality Audit

All authorities appreciated the reporting and QA aspects of the system, and some commented that these facilities were a considerable improvement on their own current practice.

Most authorities commented that the ‘flag consultee’ operation was useful, but should also indicate precisely what to consult about – this is intuitive at present. Swansea, in particular, commented that the progress tracking of an application and the ability to go offline and return to the point of processing worked well and was extremely useful.

Glasgow recognised the usefulness and potential of the system for other in-house operations, e.g. generating desk study reports for geotechnical issues.

Newham questioned the usefulness of the system to check reports supplied by the developer, as the EISP provided too comprehensive an investigation of environmental concerns for planners (this was a comment from a planner support technician). The main comment from the authority planners that is of great interest here, was that the reports supplied by developers were often of poor quality with respect to environmental concerns, and that these issues were only highlighted during planning approval.

Training

All authorities identified the potential of the system as a training tool for new staff – this was an unexpected positive outcome for future use of the system. Very few of the staff employed in planning departments have any background in the environmental sciences and have to climb a very steep learning curve with respect to environmental legislation and the impacts of development on biodiversity. In addition, some authorities have a high turnover of planning staff and some applications are processed by staff that do not have in depth local knowledge of an area. The system ensures that relevant environmental issues are considered, and this was felt to be of considerable benefit. The flow charts themselves are the key training tool.

Data and visualisation

Several local authorities (Swansea/ Telford) expressed concerns about access to and the validity of data. The system was praised for its metadata system, which is unique.

Some authorities commented that they would like to see greater use of map outputs to illustrate the progress of each enquiry through the logical flows. Although the system allows interim reports (including maps) to be generated and accessed at any time during the flow, the information is not always repeated graphical user interface. (This requirement is actually quite easy to deliver for those flows that do not already include the necessary functionality).

Performance, inter-operability and architecture

All authorities praised the speed of system entry, login security and data input. However, it was generally felt that data input is tedious and that an operational implementation should be capable of accessing existing planning details automatically, through links to back office systems. Although the ability to digitise a site interactively was recognized as important, it was felt that an address search tool / postcode facility should also be available.

Telford and Wrekin authority were hampered by their IT connections with the World Wide Web, which at times caused the system to slow down and stall. Although this was seen as a temporary problem, it could be avoided if operational implementation of EISP was as a component of the authority's back office systems.

It is clear that there are significant benefits in using the World Wide Web to access continually updated data generated by external providers such as the Environment Agency. The fact that a significant proportion of these data are (or can be) published by data providers in formats that comply with existing local authority systems adds weight to the case for configuring future versions of EISP to interface with LA in-house computing systems, since this will greatly simplify the task of updating and maintaining the underpinning databases.

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Chapter 7 A business case study for production implementation of the EISP

This chapter addresses costing the creation of a production EISP and the costs of potential commercial rollout.

7.1 The PARSOL Expert System ‘Do I need a planning application?’

Starting in 2003, at about the time the EISP Phase I development was completing, the ODPM Local e-Gov National Projects Programme PARSOL (Planning and Regulatory Services Online) project funded several deliverables. One of these was the development of the logical scripts and three pilot commercial company implementations for a public-facing, local authority web page or phone helpdesk expert system to help answer the question ‘Do I need a planning application?’ Between 2003/4 and 2005/6 the creation of such scripts (logical flows to use EISP terminology) (at a very approximate cost of £40k), their iterative refinement after the first pilots were produced (at a very approximate cost of £40k), and implementation within three pilot councils (Birmingham, Harborough and Waverley - £695k for the three) was funded by ODPM, to an approximate total cost of £775k. This system involved local authority planning expertise capturing logic as Visio diagrams (and publishing them on the public PARSOL web site for any commercial company to use). Its role within the planning system and the way it could be rolled out through funding commercial companies to create pilots that they could then go on to include as products of their own, were recognised in 2004 as a very relevant model for the roll out of the EISP.

Within Phase III, described in this report, the DCLG encouraged use of the PARSOL expertise to explore the possible options for moving the EISP to production systems. Indeed, some of these PARSOL expert systems used as many as six environmental datasets within the questions being asked and answered, in a very similar way to the EISP. The principle difference was that the expert systems hid some of the logic of how conclusions were drawn, whilst as a non- ‘black-box’ decision support tool the EISP is designed to record and show all the logical steps followed to the user.

Accordingly, we have received a great deal of background experience from Martin Howell, the PARSOL Planning Chair, and Jim Worley, the leader of the Expert System Project, and have gone on to speak in detail with all the commercial system implementers. Also, we were encouraged to use PARSOL-involved (but not EISP development-involved) LPAs for estimating the level of demand for an EISP type system in LPAs generally.

Each of the three PARSOL pilot local authorities worked with a different systems integrator to build the expert system, each with a budget of £200k+, to include both local authority staff time and the development time of the IT company. These three companies are now called Northgate Land and Property, Caps Solutions (formally part of ESRI-UK but now separate with a still close relationship) and Team Knowledge. All three had a history of providing solutions to LPAs in the planning domain with the latter specialising in capturing knowledge and expressing it in IF-THEN-ELSE style web based logical flows. Team Knowledge has gone on to supply more than two dozen similar systems based on the PARSOL Expert System scripts to other local authorities; Northgate has supplied a handful of systems to its customers and will continue to do so when asked by them; Caps Solutions has very recently added the Ebase Enterprise Workflow Management system to the infrastructure of its standard LPA Uni-form e2e back office planning suite. This latter development is very relevant, as apart from Uni-form Planning having been purchased and used by approximately 50% of all English LPAs currently, the addition of the Ebase capability has meant that is has been relatively quick and easy for them to add the logic of the PARSOL Expert System to their suite (which they did from July 2007). As will be discussed below, it will be very straightforward for them to add the logic for the EISP, also given that a majority of local authorities already store and query their relevant environmental datasets in the Uni-*form*/ESRI GIS databases.

It has to be said that expansion of sales of implementations of the PARSOL Expert System has been slow to get underway and even Team Knowledge are looking to 3rd parties, using their specialist software, to deliver such systems in the future as it is not their core market focus and customising and installing such systems in each local authority takes time. It is also worth recording that each supplier involved with the pilots found that

They spent more in terms of staff time developing the pilots than they were funded for from the ODPM core funding. That is, it is not true to say that the pilots were 100% publicly funded. This under-funding was due to the difficulties of estimating the cost of the pilot development of such systems. Each company has used the experience of this process in helping to better estimate the costs of future involvement in such projects.

7.2 The DCLG Planning Portal: www.planningportal.gov.uk

From the early stages of the development of the EISP the researchers have watched the development of the ODPM/DCLG funded planning portal and liaised with staff at their Bristol office as appropriate. A key issue for the business case for a production EISP has been whether a single EISP could be built for all English (or Welsh etc.) Local Planning Authorities and serve as a central web service 'alongside' or as part of the planning portal. However, it is a confirmed research result that approximately 50 environmental datasets are required for use within an EISP that addresses, with due diligence, the planning policy issues promoted by the PPGs (Planning Policy Guidance) and replacement PPSs (Planning Policy Statements) which the current EISP attempts to cover. It should be noted that noise is well recognised as being 'missing' from the EISP as an 'environmental planning issue.' This is because 'noise' is outside NERC's research capabilities. However, 'noise' as a planning issue, following EU legislation, probably will be covered by nationally supplied resources/systems within the planning system.

Approximately half, that is, 25 are datasets that are collated nationally and are available for licence to local authorities from centralised organisations, such as the BGS. The other 25 are only collated locally by each individual planning authority. An attempt was made by a commercial data management company to collate such a local dataset on a national scale and licence it for use in the planning portal but this did not come to fruition. It would be very difficult to maintain, acceptably, these 25 datasets in the long term.

Discussions with David Jemitus and Chris Jones of the Planning Portal have made it clear that, whilst the Portal is used for engaging users into the planning system at local authorities by, for example, allowing the submission of completed applications to registered local authorities as a service, the medium term plans for the development of the Planning Portal do not include developing it into the amount of iterative, interactive, detailed planning process that is involved within both the full application and pre-application enquiry modes of the EISP as a tool for planning officers. In particular, it is difficult ever to envisage services within a central type web portal being able to handle the back-and-forth interaction between applicant and local development control or management officer. Such iteration will always have to take place 'locally'. There is a developing business case with the Portal (current project name 'Portal 360', previously National Planning Constraints On-Line: NaPCol) for the development of a web mapping system that could show some environmental GIS constraints to help prospective applicants be aware of potential environmental issues around their applications. However, this is clearly not intended to be using publicly useable licensed datasets that are at appropriate resolution and certainty that they can be used in the detailed planning application management process. This, combined with the general push from DCLG that each local authority should provide e-planning services themselves, for example, many PARSOL expert systems rather than one for England (partly due to the practical need to customise each logical flow to each authority's way of doing things: the 'local' local plan polices – the evolution to Local Development Framework documents, makes no difference here; local interpretations of the national planning guidance and policy etc.), it is clear that a possible model of a single EISP for England, say, is not a feasible option in the long term. Each EISP system will have to be built into the standard back office planning systems of each LPA, with possible exposure of parts of the system to the publicly viewable local planning web pages in the future (as in the Caps Solutions Public*Access* option).

7.3 Intellectual Property Rights Associated with the EISP

For a local authority that wants to purchase an EISP there may be three costs involved that must be estimated:

- the cost of any IPR 'licence' involved in using the design;
- the cost of purchasing the configured software from a commercial supplier (with the earlier related development costs to that supplier);
- the cost of licensing any further environmental GIS datasets that the LPA does not currently already licence (or own itself) to fully populate the system for complete use.

The IPR associated with the EISP is quite clear in that it has been jointly invested in by both NERC Thematic Research Programme funds and DCLG and its predecessor bodies research funds (although many local authority staff have contributed to the development without external funding) and so the IPR is deemed to be "vested jointly" between DCLG and the NERC Consortium. Within the NERC Consortium 'joint share' it has also been clearly stated that BGS owns 33%, CEH owns 33% and the University of Nottingham owns 33%.

At this stage, it is worth noting that the PARSOL Expert System Project realised that clarity was needed with regard to its IPR, as it moved to encourage commercial companies to take the system on and roll it out commercially. A formal written process took place that gathered such development strands of IP rights together and firstly assigned them 100% to Wandsworth Council as a national project work package supplier and then they were handed over to the current 'holder' of this PARSOL Expert System, the Planning Advisory Service (PAS), as the PARSOL project itself was completed and wound up.

The DCLG has made it clear that they do not see it as appropriate for them to make charges for the use of designs that they have helped develop and so there is no IPR cost to developers using the PARSOL scripts or, *from their point of view*, to anybody who wishes to build an EISP. The NERC Consortium has considered, as one model of commercial roll out, that there might be a small (£100?) IPR charge against each EISP system installed. However, this small charge only complicates matters for potential commercial suppliers and would not produce serious financial returns even (and when) every LPA in the U.K. installs an EISP. Also, it was considered that the important outcome of the research should be that such systems be installed, rather than income realised (although it may lead to wider data license sales for the likes of some parts of the consortium such as the BGS). Consequently, the NERC consortium has decided that, in principle, no such charge should be made. That is, there should be no IPR licence charge made on any EISP systems that are developed to production mode and installed commercially, even though the detailed consultations with the PARSOL suppliers were completed under a signed confidentiality agreement.

7.4 The Cost of Developing and Purchasing a Production EISP

With the cooperation of the three pilot PARSOL Expert System suppliers and based on their experience of developing such a similar web based, logical flow and GIS query-based planning system, we have compared the complexity of the EISP and asked them how much they judged (from real relevant experience) it would cost them to develop a pilot production system. From this, we can estimate how much to ask the e-planning Board to consider funding such pilots, as with the PARSOL system. We also asked for how much, within their standard suite of offerings, the three suppliers might expect to sell a fully developed production system to local authorities.

The Coldfusion v5 prototype ‘Telford only’ EISP system to September 2006 contains:

- 43 interface javascripts;
- 3 metadata input scripts;
  12 coldfusion flow ‘show progress’ scripts

- 53 flow control scripts (for the topics);
- 36 coldfusion tag system ‘steps’;

- 21 more ‘system ‘scripts;
- 384 coldfusion tag ‘steps’ or environmental topic ‘questions’ within the logical flows which break down per Development Control topic into:

  Proximity to Landfill (module 1) = 19 steps

  Biodiversity (m2) = 49 steps

  Contaminated land (m3) = 50 steps

  Flood (m4) = 6 steps

  Natural heritage designations (m6) = 29 steps

  Man made heritage (m8) = 49 steps

  Shallow undermining (m9) = 32 steps

  Groundwater (m10) = 109 steps

  Air Quality PM10’s (m11) = 11 steps

  Air Quality PM10’s strategic = 11 steps (6 different from DC version)

  Drainage (m12) = 13 steps

  Landslip strategic (m21) = 6 steps

Of the above 384 steps/questions, 88 query a GIS dataset, that is, a little less than 25%. The remaining 75% of questions are interacting with, and asking questions of, the planning user of the system. So, whilst EISP can be considered a sophisticated web served analytical GIS, it is more appropriate, perhaps, to describe it as a logical query flow system with sophisticated use of a large (47+) number of targeted existing spatial digital datasets within the Local Planning Authority domain of interest.

It should be noted that the above steps may be considerably added to, if the proposed (derived from proof-of-concept prototype experience) logical flow ‘specifications improvements for a production system,’ as documented in the EISP User Guide Version 2 in Appendix 5, are implemented.

The number of similar steps in the PARSOL Expert System, latest version 27/02/2006 Visio diagrams is approximately 335 (219 automated decisions including a dozen GIS queries and 116 user input queries). Therefore, the EISP can be thought of as roughly equivalent order of magnitude size/complexity to the PARSOL Expert System.

This conclusion was reached after detailed discussion with Team Knowledge, in particular, to ensure that technological viewpoints of each 'step' were being correctly compared. The result that EISP was comparable to the PARSOL expert system was a complete surprise given that the EISP had 11 major logical flow divisions and the PARSOL Expert System had the equivalent of only about 4. What made the PARSOL system relatively more complex per functionality and capability seems to relate to the requirement that the publicly-facing expert system needed to be 'legally tight' and the EISP as a fully audit trailable tool for planners, rather than an expert system, did not need this extra overhead. Whatever the reason, it was extremely convenient that the potential suppliers felt much more confident about costing such a system of similar form and size based on their experience.

We asked each interested supplier the following two questions:

1. What would be the internal cost of building such a production system using your technologies? This figure also can be used as a guideline figure for what might go into the e-planning Board bid for building a single production 'Beacon' system in a single Local Planning Authority. Each supplier could reference the costs of building the PARSOL expert system 'pilot implementations'. A 'ball park' figure only was requested, rather than a detailed costing.

2. Given your similar licensing cost to LPAs of similar 'products,' what would be the 'ball park' cost to an LPA of purchasing such a system? This figure will be used to gauge interest in LPAs who have not been involved with the development of the EISP. This figure might consist of a basic infrastructure cost and then a cost per 'Environmental Topic' (for example, the 'contaminated land' module), as some LPAs may want to purchase only some topic modules as all of the modules may not be relevant to their area. On the other hand, the pre-application 'first third' of the system is likely to be populated for *all topics* anyway, wherever it is used. This is particularly the case with the advent of the 'Planning Application Requirements' (= 'Environmental Statements' to be provided up-front with the new standard national planning application forms known as '1app') to be implemented from April 2008 (Planning Portal 2008). It is possible that splitting the environmental topics up into separate estimates would be too time-consuming to be worth doing,

depending on how each company views its products. It is worth noting that the environmental topic-centred and modular approach to these environmental issues within the overall system means that the infrastructure is there for adding more modules very cost effectively, for example, minerals strategic planning or a tool for Strategic Environmental Assessment.

Costs obtained from each potential supplier, which it should be noted, starts, in each case, from a different technological base and from a different situation in terms of what might already be installed in a customer local authority from their existing suite, ranged from £30,000 from one supplier to £60,000 from two of them and figures for the potential cost of installing a 'mass produced' production EISP in a new LPA customer ranged from £10k-£18k. Together with the following estimates for populating the EISP with required national available datasets, these figures allow us to ask LPAs if they need and can afford an EISP.

7.5 Costing the Licensing of Externally Provided Environmental Datasets

It was observed that each LPA is already providing itself with about 50% of the required datasets to enable an EISP, often within rapidly developing corporate GIS database systems already linked to back office planning systems. The EISP research identified data from BGS, CEH, the Environment Agency, Landmark Information Group, and The Coal Authority that was required nationally, that is, to cover the area of, and be provided to, each local planning authority in England to fully and diligently implement a production EISP. For each EISP step question that used one of these entities datasets the following seven questions were asked of the dataset owner (note: it is not necessary to see or own a copy of a dataset; often, it is only required to query, that is, ask questions of, such data):

1. The median English Local Planning Authority area is 360 square kilometres; what would be the annual (or 5 year etc) license cost to such an authority for the use of each of the above datasets in an EISP used by Development Control planners and/or their environmental technical advisors from their desks (intranet based system – would a standalone GIS system make a difference)? (Note: data are queried but not necessarily available for viewing in detail). State for how many 'simultaneous users' this would apply.

Dataset X:

2. Do you already licence/sell such data to English LPAs and, if so, can the existing dataset licence be used also within this EISP system at those LPAs?

3. Are you a multi-channel dataset provider? That is, are you prepared for your data to be available to local authorities through the EISP system as well as other licence channels that you have?

4. If your dataset is used only in the preliminary pre-application enquiry part of the EISP system would it make a difference to the above licence cost?

5. If part of the system for example, the pre-application enquiry system, were available for use by the general public on your local authority website, what would be the licence cost to the LPA of that public web use?

6. The Planning Portal has asked us to ask: If the pre-application enquiry questions were available to the public for use as part of the Planning Portal's coming 'Planning Constraint' check facility, what would be the licence cost to the Planning Portal for such use?

7. What are the appropriate contact details for licensing such datasets from your organisation for use in the EISP in a Local Authority?

The results of the questionnaire can be usefully summarised quite briefly.

The Environment Agency can provide the data and in collaboration with LPAs is creating further relevant national datasets over time. Their datasets are already provided at zero cost to LPAs for use in planning work under the Water Resources Act etc.

CEH – the PM10 air quality tree planting amelioration model would costs about £3000 to create for a typical English LPA.

The Coal Authority data for the shallow undermining EISP topic is currently only available commercially through a web site-based report system which costs £50, inclusive of VAT, per 'development site.' Within twelve months they will consider supplying these data to suit an EISP ("currently in discussion with planners how best to supply them with this information").

Some months after this original response was collated, the BGS met with the new board of the Coal Authority and had the opportunity to make a presentation on the potential of the EISP. Following that meeting the Coal Authority was able to state that: “In principle, the Coal Authority is keen to licence its data to individual local authorities in a GIS form that will allow the use of it within the EISP system and is considering how to do this”. It can be concluded, with confidence, that within the project development time of a production EISP, starting in the financial year 2008-2009, such Coal Authority data will become available for use with the EISP. This was important, as this suite of vital data was, previously, the only one that had a question mark over its national availability for a production EISP.

Landmark Information Group Ltd’s Historical land use data for the contaminated land flow would cost £10,000 (or £2500 for each of 5 years). However, many LPAs have already licensed this and are allowed use the data under that license within in EISP.

The flexibility of many of the data providers in being willing to allow re-use (in many cases more appropriate use) of datasets already licensed has been exemplary. Each dataset provider has had to think forward towards EISP-type web-based systems for the near future.

The BGS data required for groundwater, contaminated land, shallow undermining, landslide and other geohazard topics: DigmapGB50 + GeoSure for a median sized LPA is £1215 per annum. The imminent BGS/HPA radon dataset will cost approximately £100 per annum and the Wellmaster index level data is free. However, 53% (the figure may be similar to Landmark) of English LAs already licence such data and can use the same license for an EISP.

In short, all national datasets identified as important will be made available in time for a production EISP and the additional license costs do not appear to be a significant negative factor in local authority decision-making regarding implementing such systems, as no local authority indicated that these figures were critical to such a decision. Both the non-national coverage availability and perceived potential cost of such datasets used to be considered critical by many when the EISP was first being developed early in the decade. It would seem that EISP has been pushing against an open door in the evolution of data availability and the appropriateness of its use for application within UK environmental planning policy since the turn of the century.

7.6 Total costs to a UK Planning Authority considering purchasing a commercially available production EISP

The cost of purchasing and installing a commercially available EISP in a new Local Planning Authority would consist of two parts:

1. The cost of purchasing a licence to use the software. This is a one-off cost. However there would be the usual annual software maintenance agreements in place (often of the order of 10-15% of the capital cost of such software). The potential software suppliers above have estimated this capital cost to be between £10-18,000.

2. The cost of licensing externally provided environmental decision aiding and 'due diligence' enhancing data that the Local Planning Authority (LPA) does not licence already. The cost of licensing such data per annum is dependant on how much of the data a particular authority already licences. At least two major suppliers to a very significant percentage of LPAs have stated that if an LPA already licences the data they may not need to increase their licence costs for its use within an EISP. Second, the cost will depend on how much use a particular LPA needs to make of a dataset where charges are made 'per query' (for example, The Coal Authority data). Taking these factors into account, we estimate that a conservative annual licence cost range of between £10-30,000 should be used. It should be noted that there will be examples of LPAs that will not have to increase their licence costs by even the lower limit of that range.

To combine these two costs to get a total and to accommodate these ranges and to allow for annual versus capital costs, a three year annual average has been calculated. This ranges between the lower purchase cost + 3 times the lower licence cost and the upper purchase cost and the upper licence costs thus:

£10,000 + 3 x £10,000 = £40,000

and £18,000 + 3 x £30,000 = £108000

Dividing these figures by 3 gives an average annual cost range of between *£13,300* and *£36,000*.

Such a cost for a new IT-based system within LPA's is similar to, or smaller than, that of other systems that they have installed in recent years.

7.7 Benefits of an EISP within the UK planning systems

To determine the likely benefits to Local Authorities in financial or time terms - how could Local Authorities justify the cost for an EISP?

This will be answered in terms of the questions posed in the original business case proposal.

7.7.1 The cost of EISP not being implemented in terms of wasted expenditure in the first place and additional cost to development projects and buildings.

Figures for assets currently at risk from four environmental issues - flooding, shallow undermining, landsliding and contamination - have been looked at in detail. This analysis gives an indication of the level of possibly unnecessary expenditure made if planning policy and scientific information are ignored.

The total value of assets at risk of flooding and coastal erosion in England, alone, is estimated to be £237 billion. Approximately 10 per cent of existing homes, housing 5 million people, are located in areas at substantial risk of flooding. Approximately £600 million of public money is being spent each year on managing flood and coastal erosion risk to existing assets and properties (Department for Communities and Local Government 2006a). It is estimated by the Environment Agency that losses from the floods of April 1998 in Central England cost £400 million, those of the autumn of 2000 across many parts of England and Wales cost £1 billion, the Boscastle flood of August 2004 cost £2 million and the Carlisle floods of January 2005 £450 million. More recent flooding in June and July 2007 is estimated to have cost insurance companies around £1.5 billion and the Government has pledged some £14 million to help support those worst hit (Woolf & Lawless 2007).

A value for assets at risk from landsliding can be calculated from the estimate of the number of houses in areas of possible landslide (Hughes 2007) and from money spent (for example, on remediation) per year because of landsliding (Oldershaw 2001). 370,000 UK homes are thought to be in areas of potential landslide hazard. If an average house price of about £210,000 is assumed, (Department for Communities and Local Government 2007) then an estimate of assets at risk is in the order of £78 billion. Whilst this is obviously an underestimate of the risk, as no account is taken of risks to other infrastructure such as roads, railways and pipelines, the actually annual cost of landslides is substantially less. Overall figures for annual losses have not yet been compiled (though the British Geological Survey is currently gathering data). However, available evidence suggests that, currently, several million pounds are lost annually due to landsliding, particularly in the coastal zone. The loss of the Holbeck Hall Hotel in Scarborough to landsliding in June 1993 is thought to have cost around £3.5 million in compensation and remediation costs (Forster & Culshaw 2004). Engineers estimated that diversion of a road at Rhiw in North Wales as a result of a landslide in 2001 cost about £2 million, while remediation costs for the Nefyn landslide of January 2001 were about £0.25 million. The extent of landsliding in Wales is highlighted in two conference proceedings (Siddle *et al.* 2000, Nichol *et al.* 2002). West Dorset District Council is proposing £15-20 million worth of works over seven years to extend the protection of Lyme Regis from coastal instability and landslides, having recently completed £17 million worth of work in 2007 (West Dorset District Council 2007). Similarly, £7.3 million has been spent on landslide stabilisation work in the Severn Valley near Ironbridge, Shropshire (House of Commons 2007a).

The value of assets at risk from shallow undermining are not as easily quantified. This is due to the fact that losses resulting from instability and the costs of remedial or preventative measures are spread widely through the community. However, it is known that private sector insurance claims for subsidence damage are of the order of £100 million a year (Department of the Environment 1990) and that the Coal Authority holds over 500,000 subsidence and damage claim records. In 2001/2, 1552 new claims were received by the Coal Authority and the total cost of claims settled was just over £10 million, (Coal Authority 2002). In addition, English Partnerships has been funding a Land Stabilisation Programme on behalf of the Department for Communities and Local Government for abandoned non-coal mineworkings. So far, this has covered limestone mines at Combe Down, near Bath (£154 million) (House of Commons 2007b), salt mines near Northwich, Cheshire (£29 million) (Northwich Vision 2007), chalk mines in Reading (£4.2 million) (English Partnerships 2001) and clay mines in the Severn Valley, near Ironbridge, Shropshire.

The value of assets at risk from contamination is again difficult to quantify. The amount can be estimated from the area of brownfield land available for development in the UK, which is about 66,000 hectares (it is assumed, here, that all brownfield land is contaminated; clearly this is not the case and some greenfield sites may also be contaminated). This land, according to figures supplied by housing authorities, could provide 950,000 homes, which could potentially put at risk assets worth about £200 billion (using the same average house price as previously) (Land use Database 2004, National Land Use Database of Previously Developed Land 2003). This does not take into account the number of assets affected if contamination of groundwater supplies takes place (it provides 70% of public water supply in South East England). In the past 30 years poor water quality has already led to the closure of 146 groundwater sources leading to the loss of 425,000 cubic metres of water every day, enough to supply nearly 3 million people (Simple 2006). Groundwater quality problems in the UK have cost the water industry about £754 million since 1975. Operational costs will rise due to increased treatment costs and could reach £180 million by 2027 (UK Groundwater Forum 2008).

Additional costs to development projects can be caused by project delay and remediation costs. A review of construction practice in the UK in the 1990s indicated that the largest element of risk to development projects was related to ground and groundwater conditions (Site Investigation Steering Group 1993). For example, 37% of projects included in the study suffered delays due to unforeseen ground conditions.

Damage due to instability may necessitate expensive remedial action or, in the worst cases, result in loss of buildings, structures or of productive land. If not foreseen before the commencement of development, problems arising from instability may result in delays and in increased costs. At worst they may result in the development being abandoned and investment being wasted (Department of the Environment 1990).

Annual insured losses in the UK due to 'subsidence' caused by geological hazards are estimated by the Association of British Insurers to be some £3-400 million in an average year, and double that sum in a bad year. Analysts predict that these figures will rise considerably in the future because of the higher frequency of extreme weather due to climate change. The Association of British Insurers predicts that by 2050 the figures could rise to £600 million in an average year and £1.2 billion in an extreme one (Hughes 2007). If planning policy statements are not adhered to in a structured and coherent way then these figures could be far higher resulting in uninsurable developments and, in the case of homes, blighted and unsaleable properties.

7.7.2 The benefits of implementing the EISP system, simply in ensuring that the best available environmental datasets are used and the PPGs and PPSs complied with.

The benefits of Planning Policy Statements (PPS) are that they improve the strategic approach, suggesting when environmental issues should be considered in the planning process. Evidence suggests (Department for Communities and Local Government 2006a) that when a PPS strategic approach is followed the environmental issues become clearer and better judgements can be made as to whether development is appropriate or not. By working in partnership with other organisations, solutions can be found which benefit the community whilst not placing people at increased risk (i.e. of flooding, landsliding, shallow mining, contamination etc).

The cost of developing a PPS, in terms of the research on which it is based, and the development of that research into policy may be in the region of about £2 - 3 million (research contracts let and internal Departmental costs). The value of assets at risk from environmental impacts is many £ billions (see above).

The risk in not issuing PPSs is that planning authorities will adopt planning policies and take development control decisions that are of an inconsistent nature and which are less likely to be in accordance with the government's wider policies (Department for Communities and Local Government 2006b). Furthermore, absence of guidance would lead to greater uncertainty for both developers and local planning authorities, which is likely to increase the cost of development proposals and lead to delays in the development process (Department for Communities and Local Government 2006b).

If no system is in place to ensure that the correct environmental datasets are being used across the whole county and that policy is being followed, then this money is in danger of being wasted and government policy will not be followed uniformly. Resulting developments will be put under increasing risk from environmental factors, which will increase over time due to climate change.

The Secretary of State looks to local planning authorities and developers to implement the advice in these guidelines. However, the specific policies and practices to be adopted by a local planning authority are for them to decide in the light of circumstances pertaining within their area. There is currently no system that ensures consistent application of these policies or audits the decisions made by local planning authorities.

In the late 1970s and early 1980s the then Department of the Environment realized that much useful environmental information, for example provided by the geological map, was not being used for planning and development as it was considered to be too complicated for use by most non-geologists and was not presented in a form relevant to planning and development. In particular, information on the sub-surface that could be interpreted from the map by trained geologists, could not be used readily by planners who had no geological training (Smith & Ellison 1999).

The EISP system provides easy access to environmental information for the use of which, not all planners and developers will have had training.

Benefits of implementing the EISP system include:

- Flood, landslide, contamination and shallow undermining risks will be more fully understood and taken into account in planning policies
- Enhanced insurance industry confidence underpinning developer activity in better locations, based on improved local assessment and design responses that mitigate residual risk.
- Reductions in statutory consultee objections resulting in improvements in planning performance to within the eight-week statutory deadline (Department for Communities and Local Government 2006a, 2006b, Office of the Deputy Prime Minister 2004).
- Provision of more certainty, to the benefit of developers and other applicants, in terms of avoiding the cost of failed planning applications and to local authority planning authorities, and statutory consultees, in terms of reducing the resources required for responding to inappropriate applications.
- Very few of staff employed in planning departments have any background in the environmental sciences. They have to climb a very steep learning curve with respect to environmental legislation and the impacts of development on biodiversity. The EISP can be used as a training tool to assist in their understanding of environmental issues and legislation (Environmental Information Systems for Planners: final report). In addition, some authorities have a high turnover of planning staff and some applications are processed by staff that do not have in depth local knowledge of an area. The system ensures that relevant environmental issues are considered by the officers, and this was a considerable benefit.
- Pre-application enquiries currently take up a lot of local authority time. EISP provides the ability to check environmental concerns in real time. This would save a great deal of time – not just in dealing with initial enquiries but also at full application stage (Duffy & Culshaw 2003).
- Efficiency savings through early recognition of environmental issues
- Consistent reporting that follows statutory procedures and best practice as set out in planning guidance
- Improved awareness amongst non-specialists of the extent, significance and implications of environmental issues
- Better planned developments resulting in lower risk of environmental impacts, with consequent economic, social and environmental benefits.
- The EISP automatically provides an audit trail covering the entire decision process.

7.7.3 Figures for number of planning applications with environmental problems have been identified during EISP Phase 1 research with the original five local authorities.

This will be used to estimate the likely requirement for environmental information across all local authorities.

All planning authorities recognised the need to check planning applications and enquiries against environmental considerations. Also, they are aware of the specialist skills required and the problems that this presents for the planning process. For example, Newham Council reported 1500 planning applications per annum involving some environmental judgement (Duffy & Culshaw 2003).

There are over 400 local councils with planning application responsibilities in the UK (UK Local Government Information website 2007).

Local Authority types in the UK:

Wales 22 unitary authorities
Scotland 32 unitary authorities

Northern Ireland 26 unitary authorities

England 47 unitary authorities
(34 County Councils)
238 District Councils
33 London Boroughs

36 Metropolitan Authorities

in 6 areas
- West Midlands – 7
- Merseyside – 5
- Greater Manchester – 10
- South Yorkshire – 4

- West Yorkshire – 5
- Tyne and Wear – 5

Therefore, the total number of applications involving environmental applications per annum (if Newham's figures are taken as an average) could be in the order of 500,000-600,000.

Pre-application enquiries currently take up a lot of local authority time. The participants found that the ability to check environmental concerns in real time would save a great deal of time – not just in dealing with initial enquiries but also at full application stage (Duffy & Culshaw 2003).

Arrick *et al*. (1995) and Bunton *et al*. (1996) found that in the Wigan Metropolitan Borough and the City of Bradford Metropolitan District, respectively, environmental issues had a direct influence on planning and development decisions. These covered issues such as housing and industrial development, improvements in the transport network, protection and development of mineral resources, provision of waste disposal facilities, control of pollution, protection and development of water resources, protection of washland areas and flood prevention, and landscape and nature conservation.

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7.7.5 Financial benefits within Planning Authorities implementing an EISP due to reductions in planning officer time required to process environmental aspects of planning

The DCLG have asked that a raw financial cost benefit estimate be made of the savings that an individual head of a Local Planning Authority could expect to make if they were to purchase an off-the-shelf commercially supplied EISP. A production fully integrated into standard workflows EISP has not been implemented anywhere in the UK yet.

Tests have been done using web servers external to the testing local authorities and the purpose of this report is to make the case for implementing a 'Beacon' actual production internally implemented system. Some Business Process Re-engineering, leading to more efficient use of existing staff, will also be a part of such an implementation in a council planning department and its related Environmental Health sections. So, no true trials that can reveal the full extent of time saved by very hard-pressed Development Management officers have taken place.

However, by taking extremely conservative estimates of time per planning application saved below it is possible to demonstrate that the Benefit over Cost ratio is significant just on staff time saved, ignoring the other benefits described in this report including the financial benefits of due diligence in consistently using the appropriate and available environmental datasets within the logic of planning policy and guidance.

Taking each application area of the EISP in turn:

1. Pre-application enquiries

    a) Assume 5,000 enquiries that need to be checked for any possible environmental issues a year.

    b) Evidence from planners suggests that environmental considerations for each enquiry can take between 0.5 and 15 hours to assess; assume an average of 0.75 hour.

    c) Assume that, with the EISP system, this time is reduced to 0.25 hours, that is, assume that using an integrated production EISP only saves 0.5 hour for each enquiry.

d) Assume that a junior planner's time costs £42.00 per hour (2008/2009 figure including overheads provided by Telford and Wrekin Council)

Saving per year is:

5,000 x 0.5 x £42.00 = £105,000 (1)

2. Planning applications

a) Assume 2,000 applications per year.

b) Evidence from planners suggests that environmental considerations for each application can take between 2 and 15 hours to assess; assume an average of 1.25 hours.

c) Assume that, with the EISP system, this time is reduced to 0.25 hours i.e. assume that using an integrated production EISP only saves 1 hour (Note: comments from actual planning officers who tested the EISP include – from a relatively less digitally integrated LPA – "those two runs of the EISP system took me 20 minutes, that would have taken me 2 weeks work with my standard manual system").

d) Assume that a junior planner's time costs £42.00 per hour (see above under 1d)

Saving per year is:

2 000 x 1.0 x £42.00 = £84,000 (2)

3. Strategic planning

Savings are very hard to estimate but it would be very conservative to assume that 10 days (of 7.5 working hours each) of a senior planner (at £60.00 per hour) and 20 days of a junior planner can be saved each year.

Saving per year is:

10 x 7.5 X £60.00 + 20 x 7.5 X £42.00 = £10,800 (3)

Total saving is the sum of 1. + 2. + 3.

£105,000 + £84,000 + £10,800 = £199,800

This rounds to *£200,000* per annum.

The annual costs of installation (from Section 2) is between £13,300 and £36,000 and with a conservative estimated annual saving of £200,000, then the Benefit to Cost ratio is between *15* and *5.6*. This is a considerable and credible benefit given the very conservative figures used.

7.8. Consultation with PARSOL Expert System LPAs

On the advice of the PARSOL management team, six local authorities (a cross section of District, Unitary and Metropolitan Borough) that had been involved with the development of the PARSOL expert system were invited to a meeting hosted by Birmingham City Council on our behalf. Because of their previous involvement with PARSOL, these LAs had a good understanding of this sort of system and what its implementation entailed for a council. However, none had been involved with the development of the EISP. At the meeting they were informed about the EISP, heard the results of the costing exercise described above and answered, after consultation with their colleagues, four questions to obtain their views on the attractiveness and demand for adding an EISP system to their portfolio of services.

However, without being able to show a full production version of the EISP in full time use by local authority planners, it is difficult to gauge 'true' demand. It is also sub-optimal without a full production system, or systems, to show to the English LPAs who should be interested. We can currently demonstrate only a proof-of-concept system that is not integrated into a typical local authority back office planning system and GIS.

The PARSOL Expert System has three ODPM-funded, full production systems to help generate demand and that demand is only just beginning to pick up now.

Three of the invited councils had to withdraw due to serious ill health on the day of the meeting at Birmingham council, nonetheless four positive and considered responses were received in writing. It is convenient just to list them here as exemplars of initial responses from knowledgeable local authority strategic development managers, business support managers and planning-based IT implementers within LPAs.

From Waverley:

1. *Very approximately, how many planning applications (out of how many in total) in your Local Planning Authority Area involve any of the environmental topics dealt with by the prototype EISP? (Which environmental topics here are particularly relevant/common to your area?)*

50%

Flood, Contaminated land, Proximity to Landfill, Biodiversity, Natural heritage designations, Man made heritage, Air Quality, Air Quality PM10's strategic, Drainage

2. *Could your LPA benefit from purchasing (commercial estimates cost at between £10,000-18,000 plus any non-LPA owned dataset licensing costs) a production version of the EISP: the full EISP or the primary constraint check pre-application enquiry first 'third' of the EISP with all or only some of the environmental topic 'flows'?*

Yes, possibly, although the cost is quite high for a district council.

3. *Would your LPA be interested in joining the bid to the CLG e-planning board to become another production system build partner (like the three production systems that ODPM funded for the 'PARSOL Expert System – do I need a planning application?')?*

Not at the moment

4. *Does your LPA believe that EISP would be a useful tool for CLG to develop to production version stage to be available for uptake for all English LPAs?*

Yes

From Kirkless MC:

1. Kirklees MC handles about 5000 applications per annum. About 50% will need some sort of environmental appraisal although many would only need a fairly superficial assessment (for example, flood risk/landfill gas etc.) This would reduce to about 20% for applications requiring more detailed appraisal (contamination/air quality/biodiversity etc.)

2. Possibly, although common constraint datasets are already accessed via departmental/corporate GISs. A lot would depend on how well developed the product was and whether national organisations were fully signed up to maintaining the information. The concept seems to be more beneficial to LPAs who have not been able to develop effective constraint databases and/or have not been able to integrate spatial information in application processing systems.

3. Not at this time – if the product became established as the prime source of environmental information this could change but at present our own datasets embedded in our departmental GIS together with established external data sources (HSE/Environment Agency) provide all the information we need.

4. The concept is sound but how many LPAs already have this information available on departmental systems? This could limit take up if a cost was involved, but the situation could be different if the national database was available free of charge for anyone to access. It would also reduce the number of enquiries of this nature to LPAs which would be beneficial and the CLG should consider resultant efficiencies and the contribution to e-Planning targets (particularly the ‘Better Planning’ standards, for example, 2.10/2.11) if it was able to encourage take up by making this a ‘no cost’ system.

From Macclesfield:

1. We handle about 3000 applications a year in total. Potentially, all could involve environmental topic; in practice up to 40% do. Topics include deep coal, contamination, landfill, biodiversity, air quality and, as mentioned, aircraft noise, public safety zones and safeguarding areas. Nearly all the Borough is Green Belt.

2. Possibly although integrated GIS does part of the job.

3. Not on our own. However, the Secretary of State is minded to create a new unitary Cheshire East Council. We would be very interested in having EISP in production to handle some of the integration issues across three district councils and half of Cheshire County Council.

4. Yes – subject to customisation for local circumstances.

From Birmingham:

1. We handle about 8500 applications a year in total. Potentially all could involve environmental topic, in practice up to 30% do. Topics include contamination, biodiversity, air quality and, as mentioned, aircraft noise, public safety zones and safeguarding areas. The majority of Birmingham is not in green belt.

2. Possibly, although our GIS already does part of the job and the introduction of our new planning system will also help.

3. In order for us to commit to undertaking resourcing this, we would have to carry out a cost benefit exercise as we already undertake/obtain this information quite satisfactorily.

4. Yes – subject to customisation for local circumstances.

These responses are very encouraging given that, with only a half a day introduction to the system, the major value of the core of the EISP system - the 384 logical steps/questions (rather than the 88 GIS dataset queries) that enables planning officers to implement consistently PPG/PPS and other guidance – may not be as apparent as it would be if they were able to see a production system being used within a local authority planning office. The only comment received that tested the scope of the current EISP prototype was the query “we have an additional first pass planning constraint – airport zoning – how easy is that to add to an EISP system for our authority?” Such local authority specific customisations are extremely straightforward and part and parcel of the ‘populate the EISP for this local authority’ process that would be part of any EISP production installation. In this case, it would simply involve adding the airport zone GIS query (dataset clearly already owned by the authority) to the primary constraint pre-application query part of the system.

It is important to note here that the PARSOL expert system is for the public to use (although we understand that one major implementer of this system actually has staff using it and talking on the phone to the public) whilst the EISP, in the first instance, is for planning officers to use. That is a large shift in emphasis. It has been pointed out to us that, whilst the initial government e-planning push was in automating the public-planning interface of the UK planning systems (measured by the Pendelton criteria and with the creation of local planning web pages etc.) with the publication of the PARSOL Better Planning Services Standards document Version 1.1 July 2006, focus is now on improving the back office systems of local planning authorities, that is, the actual professional planning process. In a sense, EISP, which has always been focussed there, was a little ahead of its time in the early years. It is now of its time. The ease with which these previously aware LPAs recognised and accepted the value and usefulness of the EISP-type tools is indicative of this.

There was a fifth council that responded positively to these questions and that was Telford and Wrekin Council through their Special Projects Manager, Graham Fairhurst. Despite a full year's hiatus in involvement in development of the EISP due to delays in getting this business case funding, Telford have maintained their desire to be become a 'Beacon' council for the EISP. This means that they are willing to install an exemplar production system, integrated in their back office planning processes and used daily by their officers for showing to other local authorities.

Telford already has experience on other topics in running Beacon systems and their creation and management. Appendix 4 contains the commitment letter for their involvement in a DCLG-funded production version of the EISP, including a serious estimate of the externally funded staff cost required for this to take place. Starting from November 2007 Telford's IT systems integrator (MIS-LGS) is installing a new suite of planning capability – including implementing for the first time the PARSOL expert system. Therefore, it fits very well with the development process for this council to build in a production EISP at the same time.

Both the possible systems integrators for building such production systems, and all local authorities showing an interest in being involved, were unanimous that such work could not start until next financial year (2008/9). However, that suited the possible funding round realities anyway.

The EISP development process has learnt that UK planning departments are some of the most overloaded people and processes in local authorities and, hence, the most difficult persuade to trial tools even though these will make their lives easier and more efficient.

7.9 Implications of 1App and the Local Planning Application Requirements for the Validation of Planning Applications

During this work, Planning Portal officials and Martin Howell of Wandsworth Council brought to our attention the implications of the, then, imminent roll out of the new standard national planning application forms (known as '1App' by the Planning Portal and others) and their associated nationally and locally set information requirements to allow such applications to be accepted as valid. This DCLG initiative was moving to front-loading, amongst other things, environmental information required to accompany an application *before* it would be deemed as valid (and hence the planning 'clock' would start 'ticking'). Environmental topics listed needed to accompany planning applications included nearly all of the eleven topics currently covered by the pre-application primary constraint mode of the EISP. These requirements are going to generate the need for LPAs to provide, on their local public planning web sites, precisely the sort of environmental constraint and information service that the EISP pre-application enquiry mode fulfils (for example, biodiversity/protected species/geological conservation, flood risk, trees, historic and archaeological features, air quality, open space, EIA generally). The one topic area that EISP currently covers (but that, currently, such requirements do not) is with regard to geohazards. However, by showing in the dataset costing and availability survey that geohazard data are available at reasonable cost, then, maybe, as topics are added over time to these requirements, this will be added also. It is clear to us that these new validation requirements are opening up an entirely new market demand for the EISP capabilities. Many local authorities wanting to install the EISP will probably, at the same time, want the pre-application third of it to be public-facing from the start, to enable fulfilment of these new requirements.

We discussed this with Asma Mouden of the DCLG Planning System Improvement Division, responsible for these new single application validation requirements. We noted that the Planning White Paper ("Planning for a Sustainable Future") contains a Section 9e (Streamlining information requirements for all applications) and the statement (paragraph 9.30) that "Applications will be considered valid if they are accompanied by the information specified both on a short national list of statutory requirements and on a local authority's own published list. The local authority list will be expected to include information needed to ensure that applications comply with national policies." Presumably, such policies will include the environmental planning ones above (the Royal Commission on Environmental Pollution [2002] concluded that "all planning was about the environment") and, also, we noted an intention to: "…start a review…" and "…as part of the review we will also commission a study of the information demands for applications…"

We have already identified the cost of all the currently existing nationally and local authority owned environmental digital datasets required for diligent implementation of the relevant planning policies. By showing that they can be used in IT automated streamlined planning tools, the EISP project has made a considerable contribution to the work for that review with regard to environmental datasets. That is why we have published, in Appendix 3, the full questionnaire responses, so that DCLG can use them in that review. Further insight may be obtained by discussing this further with us.

7.9 Recommendations to the DCLG E-Planning Board or equivalent for a production EISP

This business case study has costed the various parts that make up the true costs of moving the EISP to a production system and hence to the possibility of commercial take up by suppliers and local planning authorities. It has observed the former ODPM-funded PARSOL process that successfully took place to create three production systems that then led to the beginnings of widespread commercial take up amongst planning authorities. A characteristic of the EISP system is that it needs to be implemented as a production system in the back office of a willing, and appropriately staff resourced, local authority before it truly can be used to sell the concept to a wider audience. Nonetheless, it can be seen using extremely conservative estimates that, at this stage in the development of the EISP, staff time savings alone imply a considerable cost-benefit financial saving. The purpose of this study is to create the business case to support the relevant DCLG decision-making process (possibly supported by DEFRA technical interest in some of the environmental planning topics covered by the EISP) to fund such a production system or systems.

We have an offer of participation by Telford and Wrekin Council at a cost of approximately *£48,000* (all figures here are from 2008/9 onwards). Such a production system would need to be populated with some datasets that that particular local authority may not already have licensed at a cost of approximately *£20,000*. BGS management costs (about 60 person days) and involvement of the other NERC consortium staff (about 240 person days) would result in a cost of around *£150,000* to build a production system. The final contribution required is the chosen Systems Integrator for that Council, MIS-LGS. Although they have not been involved in EISP-type systems before, they have offered (as it is part of a bigger installation they are already starting for Telford and Wrekin Council in November 2006) that they estimate the extra staff time, from their point of view, would be only about *£20,000*. However, that involves integrating the logical flows, which must be built by Team

Knowledge, who only wish to work through a third party such as MIS-LGS. The cost of Team Knowledge building such a system is around *£60,000*, based on their experience with the PARSOL expert system.

In total, then, the funding that is required to build a production system in the particular local authority that is offering to do it (Telford and Wrekin) with the particular consortium of IT integrators that it is willing to work with, is approximately *£300,000* (the total of the italicised costs in the previous paragraph). It is interesting to note that that figure is not that different from the (different) per production system cost of the three PARSOL expert systems. However, perhaps that is not so surprising as we have learnt that the EISP is, in fact, of comparable size and complexity.

The PARSOL expert system had three production systems funded because different technological approaches have to be taken by different councils and the supplier industry needed to be widely ‘kick started’ to take this new product up. As it happens, Telford and Wrekin Council wish to work with their systems integrator, which is not, directly, one of the three companies that are selling the PARSOL expert system, and with the most successful of these three companies, in terms of sales of the latter, Team Knowledge. Team Knowledge only wishes to work with other third party integrators, so this would conveniently create what might be called the ‘Telford EISP implementation consortium.’ However, a single production system implemented by one type of technology will not have the impact or spread, within the supplier industry, as the three different ones had for the PARSOL expert system. It is clear that we would achieve greater impact if a second local authority could be found to volunteer for a second production system. This local authority should have Caps Solutions Uni-*form* planning system installed as approximately 50% of the English local authorities have this system installed. However, it should be noted that, whilst Telford do not wish to use this system for their planning officers (they have made the corporate decision to continue down the MIS-LGS route), elsewhere, in the Environmental Health section of the Council, they do in fact have and use this Caps Uni-*form* system. This is an indication of the depth of penetration of this particular technology. Because we and Caps Solutions suspect that implementing a full production EISP using their new infrastructure would be straightforward, Caps Solutions has estimated that their costs for such a production system would be 'only' *£30,000* (though such a second system would require extra NERC Consortium time, estimated at *£50,000,* and the staff time of that second local authority). Assuming that local authority staff costs would be similar to those of Telford and Wrekin Council (*£48,000*) and that licensing costs would also be similar (*£20,000*), the overall cost of the second production system would be around *£150,000.* So, it is recommended that the DCLG consider funding a second (but not a third) exemplar production system based on a Caps Solutions local authority user.

It may be said, by some, that, as DCLG funding for PARSOL projects has ceased, DCLG is no longer in the business of enabling the implementation of e-planning production systems. Although part-funded by non-PARSOL DCLG funding streams, it is logical to argue that the funding for EISP should be carried through and finished to the production stage, like the PARSOL projects – hence this business case study.

If DCLG wishes to see its planning policies implemented consistently in a streamlined web automated e-planning process using the most appropriate and diligent environmental datasets available, then *we recommend that DCLG funds the implementation of one, but preferably two, EISP production systems based on the business case presented here.*

The timely review by Geertman and Stillwell (Geertman and Stillwell 2009) of Planning Support Systems Best Practice and New Methods raises the question of why Planning Support Systems do not seem to have prospered in practice within production planning environments since the 2001 review. The DCLG has the opportunity to make the EISP system prosper within the UK planning framework.

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Chapter 8 Conclusions

The EISP has implemented a practical prototype that addresses the three areas of pre-application enquiries, planning application processing and strategic planning. The system is unique and far more than a standard GIS type application of 50+ identified relevant environmental datasets, as it places their use within the if-then-else 'logical flow' implementation (the design paradigm of this research) of the UK planning framework. These flows allow rapid, consistent, documented and audit-trailed implementation of the framework and the design allows it to be relatively easily modifiable as the planning framework evolves or new datasets become available or new environmental issues need to be addressed. As well as giving access to relevant UK-wide datasets, the system successfully incorporates an application of environmental (air quality) modelling. A significant conclusion reached was that such an EISP had to be production implemented as an information system at the local LPA (which is the locus for detailed planning application processing) level rather than, say, at the equivalent planning portal level. A key question raised from the beginning – was an EISP affordable and cost effective for an LPA? – needed to be thoroughly researched to see if the EISP was significantly different in practical applicability from previous academic domain only (often just 'regional' or 'small city area') planning support tools. It was concluded that such a suitable data-populated system was of similar design and build costs to other Information Systems being purchased by LPA's and that the applied environmental datasets were not prohibitively expensive to license and use within LPAs.

Other benefits to UK planning concluded from the research were:

- Reductions in statutory consultee objections resulting in improvements in planning performance to within the eight-week statutory deadline
- Provision of more certainty by avoiding the cost of failed planning applications and reducing the resources required for responding to inappropriate applications
- The EISP can be used as a training tool to assist LPA staff in their understanding of environmental issues within the planning system
- The system ensures that relevant environmental issues are considered by the officers
- Efficiency savings through early recognition of environmental issues
- Consistent reporting that follows statutory procedures and best practice
- Improved awareness amongst non-specialists of the extent, significance and implications of environmental issues
- Better planned developments resulting in lower risk of environmental impacts, with consequent economic, social and environmental benefits

The potential UK planning users of the system concluded they would significantly benefit from it if the DCLG could fund the implementation of a production system.

8.1 Further work

This thesis proposes that the time and cost/benefits of such systems has come of age and recent renewed interest in the current, updated to include the latest Natural Ground Stability (GeoSure) datasets, EISP system, by the Department of Communities and Local Government (Dr. Helen Reeves, pers comm.) may see the implementation of production systems during the next decade. The Scope of the proposed EISP as shown in Figure 4.8, describes how such a system could be extended in a modular fashion to related applications, such as testing Environmental Statements for Environmental Information Assessments (EIAs), supplying the information to the public for and testing the applications made under the emerging 1APP system, the results of minerals and waste plans, air quality management plans and Strategic Environmental Assessment. Such applications start to bring in the need for modules and data queries incorporating the social and economic considerations of the planning system and this points to a large and fertile landscape for further research.